MACHINE DESIGN

PARTS • MATERIALS • METHODS • FINISHES

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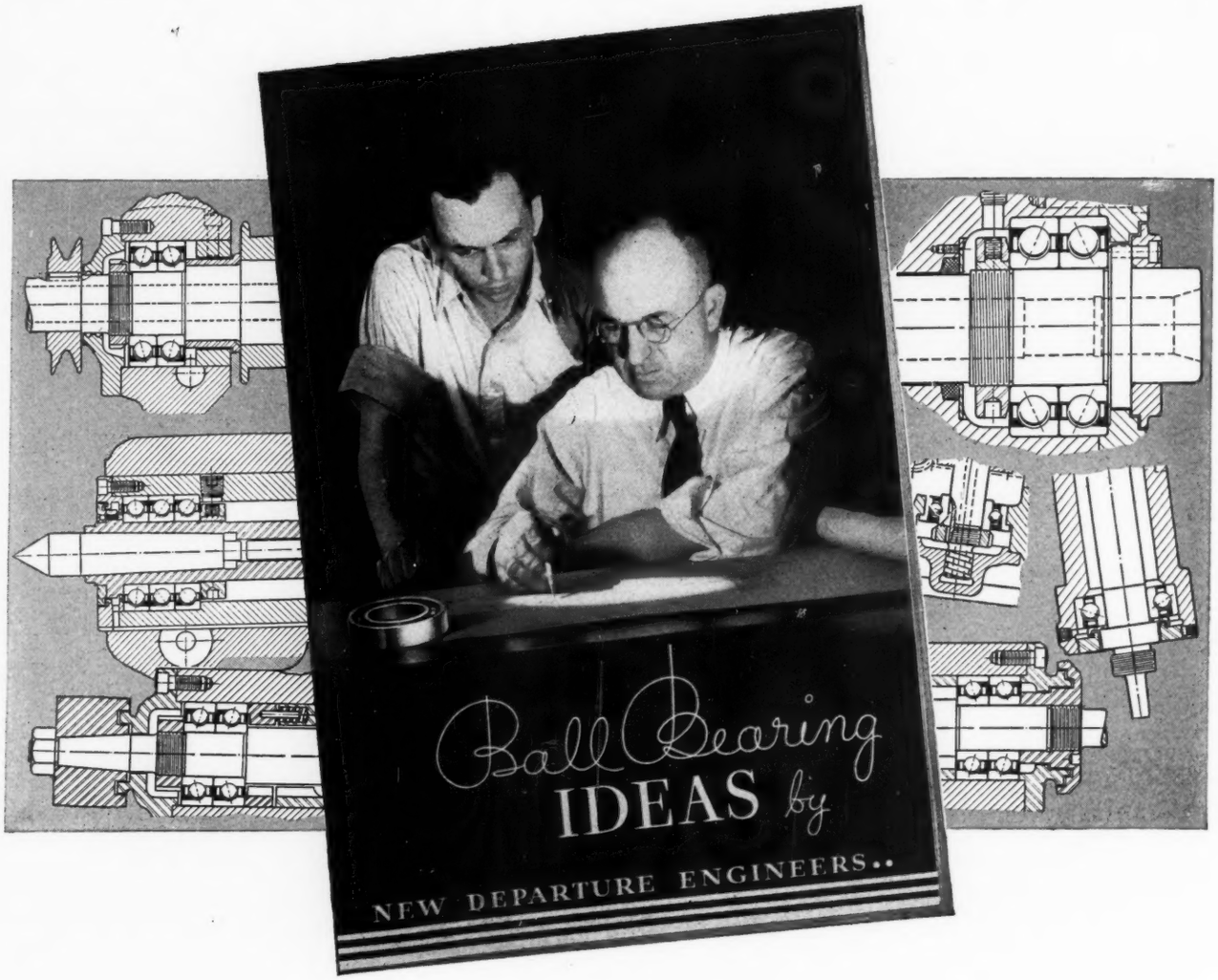

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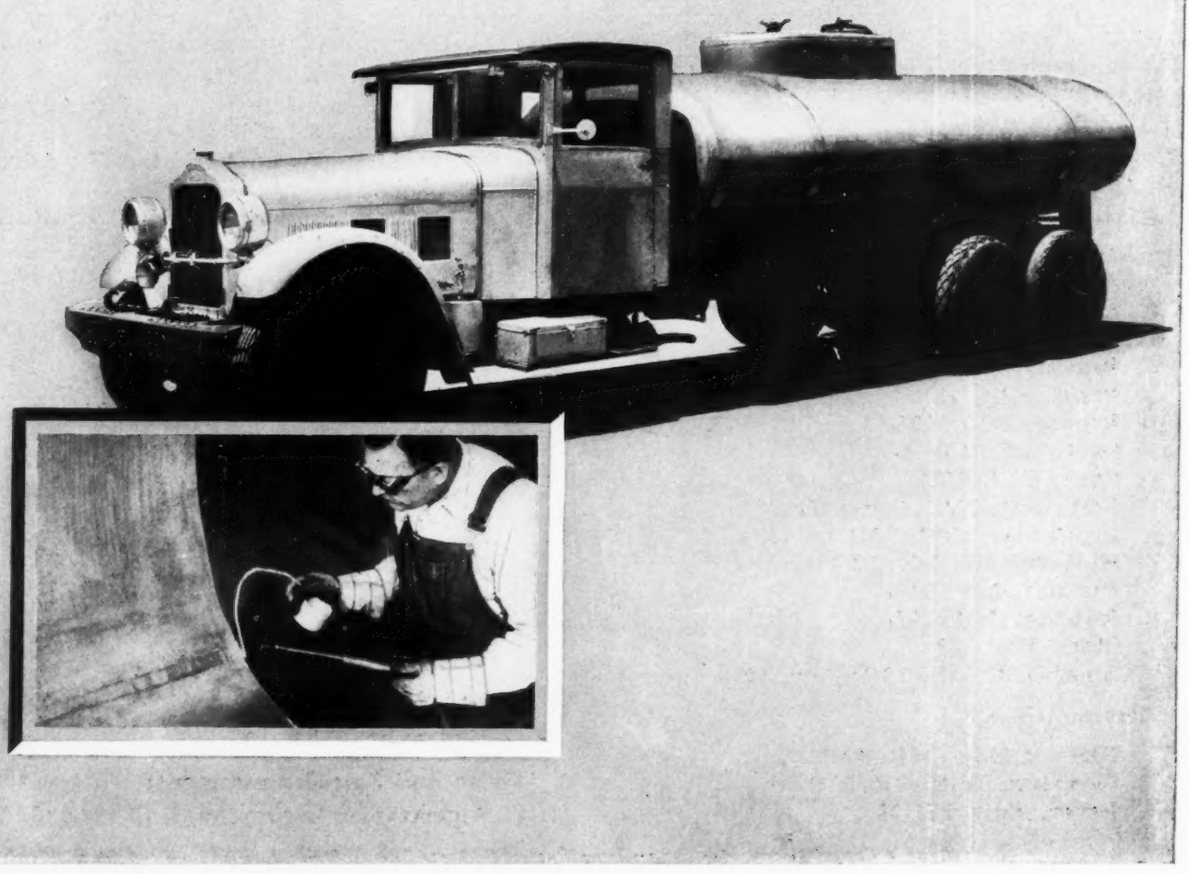

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Topics . . .

SOMEONE said the inventor is the number one "forgotten man." Apparently he didn't know about the 1935 ballot for election to the Hall of Fame on New York university campus. On this ballot no less than ten inventors are included among the sixty-six famous names listed. We are hearing a great deal more now about our inventive prowess . . . . and the way it's bringing back prosperity. Not many months ago engineers were harassed by a lot of criticism, but that comes with every depression. Technology vindicated itself by turning a deaf ear to antagonists and continuing developments that now are regarded as essential aids to better times.

• • •

The list of inventors nominated this year by public balloting is made up of John Ericsson, Robert and Cyrus McCormick, Charles Goodyear, Lewis Edson Waterman, Dr. Richard Jordon Gatling, Walter Hunt, John Fitch, Charles Edgar Fritts, James Rumsey.

• • •

America is not the only country that realizes the importance of its inventors. Soviet Russia shows its thinking through dictator Stalin. He says that invention should be part of their new technology and of contemporaneous life. Going further, the leading communist declared that his party demands protection and encouragement for Soviet inventors. Only recently a Russian engineer invented an apparatus which makes possible the control of machine tools by photoelectric cells.

• • •

If anyone thinks American auto builders are carrying the streamlined idea too far they should have seen the new Maybach at the Paris Show. No startling mechanical innovations were introduced at this year's exposition but European engineers are said to be engaged in redesigning all chassis components to accommodate radically streamlined bodies. Word comes that Voisin is developing a radial rear engine to obtain maximum advantages from streamlining.

• • •

News from Germany has it that a secret trial cruise recently was taken by a German submarine that is equipped with a circular saw designed to cut through the steel nets with which harbors and narrow channels often are guarded. Didn't someone once build a submarine with saws to cut through ice so it could be used in making a projected polar expedition?

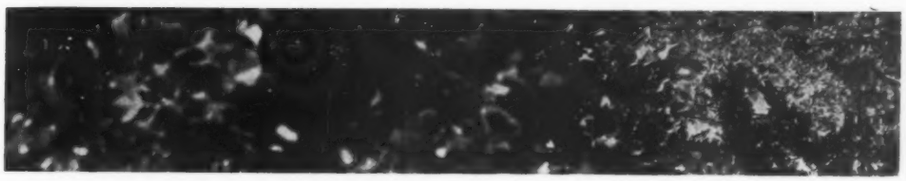
• • •

War machines are unpleasant things to think about so let's turn to some experiments that German scientists have been making in the use of dry ice to power noiseless motors. Not much information is available except that the tests are reported to have been successful. Besides absence of noise, simplicity and light weight are features of this development that is expected to have far reaching effects on motor construction.

• • •

Returning to local affairs, the index of machine tool orders for September looks a little disappointing. After registering four successive monthly gains, the three months moving average reveals a moderate decline. There is encouragement in the fact, however, that many modernization inquiries were received at the recent Machine Tool Show which augur well for renewed stimulation in buying.

MACHINE
DESIGN



Auto Design Forges Ahead

Fig. 1—A modernistic hood conceals the radiator and power plant on new Cord while headlights are retractable, to and from wells on the fenders

By Austin M. Wolf
Consulting Automotive Engineer, New York

DESPITE the advancement of the date for the introduction of the new models, automobile designers are presenting outstanding accomplishments made in the ten months' period. Noteworthy innovations introduced include overhead valve gear temperature regulation, packless water pumps, front axle radius rods, box section frames, universal joints in the steering column, and retractable headlamps. Increased engine output, combined in many cases with a reduction in car weight, gives new standards of performance. Fender, hood

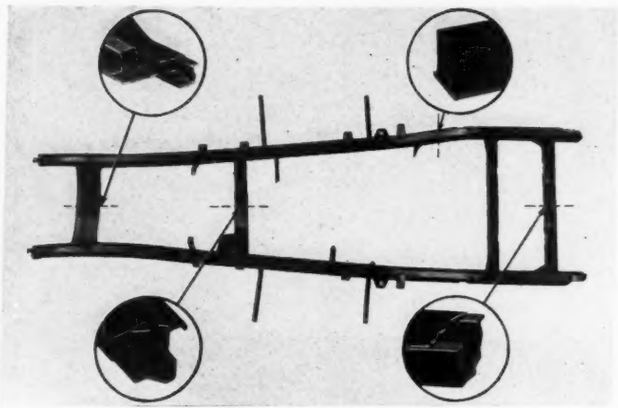
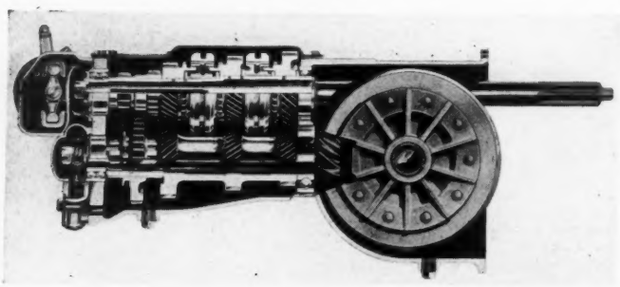


Fig. 2—Welding and inverted U-sections feature the design of new frames

Fig. 3—There is no direct drive in this gearbox used on new Cord cars



and body designs of unsurpassed beauty and excellence are all the more creditable since they were engineered for quantity production as well as appearance. Safety measures have been incorporated to enhance the operator's senses and conserve his energy.

A radical departure in the field is the new front-driven Cord in which the radiator and power plant are concealed within a modernistic hood, *Fig.* 1, with a series of "Venetian blind" louvres running entirely around it. The power plant and body each have their individual frames which are later bolted together. The gearbox, drive and front suspension are novel. By means of a crank on the instrument board the headlamps can be brought into position.

Use of Die Castings Widens

Zinc die castings with chromium plating have served an ornamental purpose for many years but the present vogue of using this material for radiator grilles has resulted in large sizes with small sections heretofore entertained as impossible. Cast grilles impart a massive "quality" appearance that cannot be approached by the stamped type. In the majority of cases a vertical bar design is employed.

Frames have been strengthened greatly in torsional rigidity in order to support the body properly. The center of the X-members have been strengthened particularly by the copious use of welding and large top and bottom plates. Welding is more generally used throughout the frame at the expense of rivets. The Chevrolet Standard frame in *Fig.* 2 has frame rails of inverted U-section whose out-turned flanges are welded every 1⅜ inches to a bottom plate. All three cross members are of rugged box construction as shown. In the new Lincoln Zephyr the body and frame are one unit.

The stamped steel wheel has the field all its own, having entirely displaced the wire spoke type. The stamped fifteen-spoke Ford wheel is five pounds lighter than its predecessor and is made of 0.110 inch stock. The rim is electrically welded on at each spoke. Bodies are more spacious in every dimension and still larger body stampings are being fabricated in the industry.

The Cord gearbox, *Fig.* 3, is located ahead of the differential in order to place more weight on

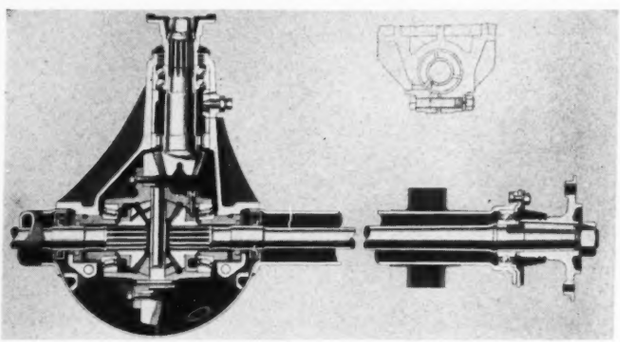


Fig. 4—Sealed ball bearings protect the rear axle shown, which is of the semifloating type

the front wheels. This is aided by the eight-cylinder V-engine which is more compact than an eight in-line. Power is conveyed from the clutch to the gears on the mainshaft which drive the countershaft below, at the rear end of which is located the driving bevel pinion. There is no direct drive. First and reverse are obtained by sliding a spur gear at the front end of the countershaft. Second, third and fourth speeds (the latter corresponding to a cruising or overdrive speed with a ratio of 2.75-1 between the engine and the wheels) are secured through 45-degree helical, constant mesh gears with synchronizers and clutches on the mainshaft. Each wheel is driven by a propellor shaft from the differential which is equipped with a Rzeppa constant velocity joint at each end.

The Cadillac rear axle shown in *Fig.* 4 is now of the semifloating type with sealed wheel ball bearings and a new design of differential. A

heavily ribbed, solid cylindrical case contains the gears which are assembled through one end and retained by a threaded ring. The unit is mounted in the axle housing on plugs supporting the stationary cone of the roller bearings. The back cover is welded to the housing to reinforce it.

A new barrel-roller bearing, seen in *Fig.* 8, is incorporated in the full floating Chevrolet truck rear axle wheel hub. The unit is self aligning since the bearing surface of the rollers is ground radially. Races are ground with a slightly larger radius so that the bearing capacity increases with load due to the greater contact area with elastic deformation.

The large Cadillac 8's incorporate a pair of metallic universal joints below the body-supported steering column and the frame-mounted steering gear as will be seen in *Fig.* 6. Relative motion between the body and frame will not cramp the gear or the post, and wheel whip and vibration are minimized. A reduction of friction in the steering system has been effected by the use of needle bearings at the top and bottom of the front axle king pins.

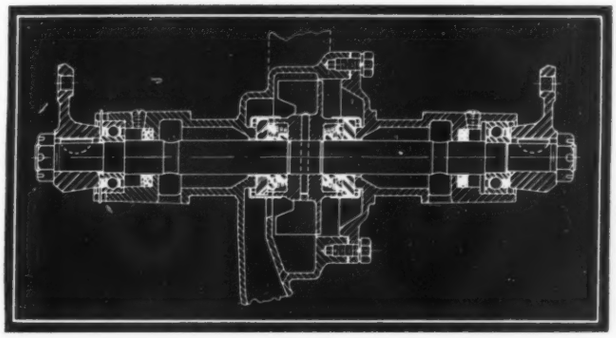


Fig. 5—Packless pump employs spring-loaded, graphite-impregnated cork washer between steel disks

Hydraulic Cylinders Are Duralumin

Hydraulic brakes are practically universal. In the Chrysler-produced cars the wheel cylinder pistons have been changed from aluminum to duralumin, and bronze is used for the master cylinder piston instead of aluminum to prevent any likelihood of corrosion. The Chevrolet wheel cylinder contains, as will be seen in *Fig.* 7, an aluminum piston pressing at each end against an end cover which pilots over the machined outside ends of the cylinder. Threaded into its center is an adjustment screw that cannot rotate since its thrust end is slotted and encompasses the web of the T-section brake shoe. An adjustment wheel welded to the end cover can be rotated for brake adjustment by inserting a screw driver through and rocking it in a slot in the backing plate while engaging serrations in the wheel. The end cover is fluted and provided with a spring lock.

The Studebaker "hill-holder" maintains the pressure in the hydraulic brake lines while the clutch is held out by providing a check valve immediately ahead of the master cylinder. This permits the driver to move his feet from the brake pedal to the accelerator on a grade and as the clutch is let in the check valve is unseated. "Duo-automatic braking" used on Hudson and Terraplane consists of an hydraulic system in which, should the pedal be moved more than three fourths of its normal stroke, a link conveys the pedal movement to the rotary equalizer of the mechanical brake. The latter consists of two cables running to the rear wheel brakes and actuating mechanically by a toggle hook-up the same shoes that are hydraulically expanded for service application. Should anything render the hydraulic system inoperative the rear brakes would still be set automatically.

Water pump speeds and loads have increased

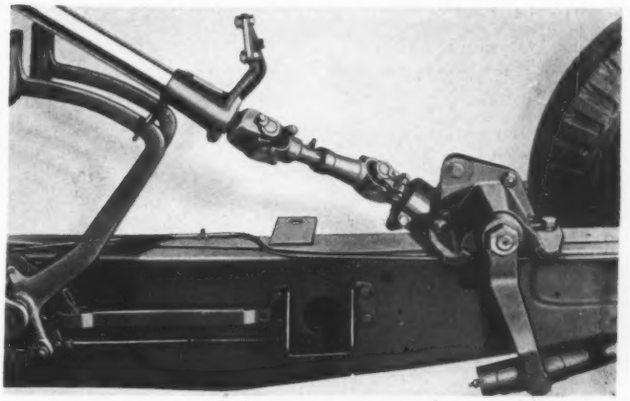
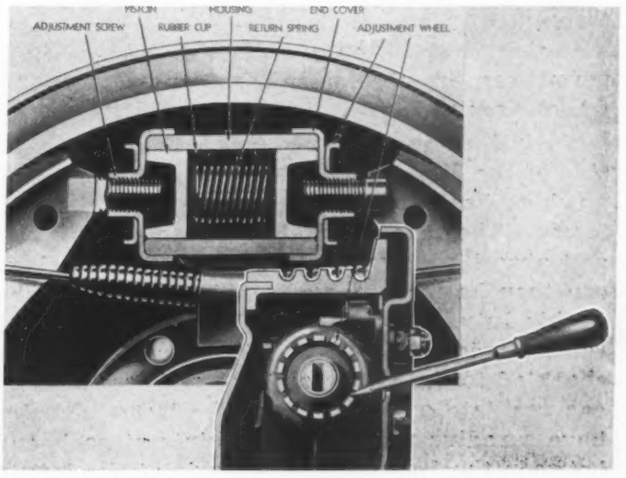


Fig. 6—Use of universal joints in steering mechanism eliminate wheel vibrations

Fig. 7—Improved hydraulic brakes employ cylinders of bronze and aluminum



and the old-type packing gland has not been satisfactory. This is being overcome today by packless water pumps. A spring-loaded, graphite-impregnated cork washer between two stainless steel washers seals the Hudson and Terraplane pump. In the Schwitzer-Cummins construction in *Fig.* 5 the sealing side of a carbon disk is lapped convexly on a large radius and contacts with the surface of the pump body which is also lapped. It is held there by a spring which also presses against the flange of a synthetic rubber member, thus making a seal between the carbon disk and the shaft. The disk has four keys fitting into slots in the impeller hub and rotates with it.

Oscillates on Roller Bearings

In addition to the drive at the front end, the Cord has individual wheel suspension in the form of a curved, pressed steel box section arm at each side oscillating on widely spaced roller bearings at the front of the power plant frame. The wheel and its mounting are held by a forged

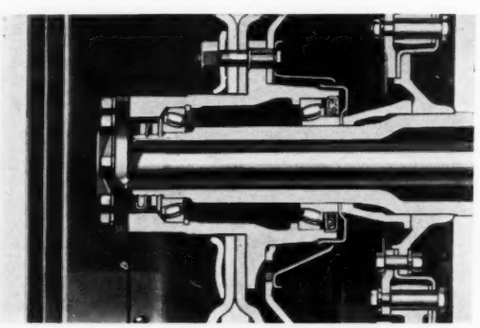


Fig. 8—These barrel-roller type bearings are self aligning

steel yoke at the other end. A transverse spring is clipped to the under-side of the second cross member and the load is conveyed to each wheel arm by means of a tension link passing through clearance holes at each member and with the interposition of rubber disk mountings permitting the necessary link oscillation as the wheel rises and falls.

Forged radius rods extend forward at each side of the Hudson and Terraplane frames with a rubber bushing mounting at the bottom of the frame. They are pinned forward to the axle bed and absorb all braking reactions. The springs can then be made more flexible, being relieved of this duty. Since the axle is positioned by the radius rods, each end of the front spring is shackled to the frame and the split spring seat can oscillate on the axle. The large Lincolns have a radius rod with ball joints at each end between the frame and front axle at the left to improve steering. There are shackles at each end of the left spring.

Through the center of the hollow rocker arm shaft of the large Buick engine is located a copper tube through which water passes from the rear end of the head water jacket to the pump inlet. Oil feeding the valve gear is within the hollow shaft and heat transfer from the thermostatically controlled cooling system warms the oil up quickly when the engine is cold and cools it in extreme summer temperatures. Some of the oil passes down over the push rods on its way to the sump and whereas the cylinders of a cold motor would expand more rapidly than the push rods in the warming-up process, this method accomplishes a better thermal equalization of the parts, reducing noise considerably. Chevrolet accomplishes the same results by passing the rocker shaft oil supply line up through the cylinder water jacket.

The steel body with steel roof presents a problem in thermal and noise insulation. An asphaltic compound is sprayed on the Nash roof and side panels against which is cemented a waffle pattern felt. A loosely matted layer of soft fibers about 1 inch thick further insulates the top. A "muffle board of fibrous material is cemented to the underside of the Hudson and Terraplane one-piece top beneath which are loosely placed strips of masonite, side by side, followed by soft blue wadding which is also loose. Below the top bows is an interlining which has no acoustical function.

Close Limits Specified

Micromatic finishing of cylinder bores is gaining popularity since the condition of the initial surfaces is a great factor in the ultimate life of the engine. Cadillac triple-hones the cylinders and holds them to within 1/10,000 inch. Its rear axle gears are held to within 3/10,000 inch and they are carefully matched to eliminate back lash. The Ford steering arm shaft is mounted on needle bearings and the worm and sector teeth are ground and lapped. An adjustable drag link permits the high spot in the gears to be set in the "straight-ahead" position. The LaSalle connecting rod is held to within 1/32 ounce by removing the necessary metal from an integral boss. The lock screw at the connecting rod small end is made up in thirteen different variations of head heights so that one screw is 1/64 ounce more than the one preceding it. Close balancing limits are then easily obtained by the proper selection of screws.

This brief summary of the high spots in the new cars clearly indicates that the designer has antiquated the seeming "perfection" of the previous models which were introduced less than a year ago. History is made on the drawing board.

Scanning the Field . . . FOR IDEAS

PRODUCTION LINE X-RAYING

WHEN opportunity knocks, the alert engineer usually has an idea to fit the occasion. M. B. Adrian was ready when industry commenced to realize that it was doing too much guessing in the inspection of materials and parts produced in quantity. He has spent many years in Milwaukee on X-ray equipment including a shoe fitting machine and thus was well equipped to develop the idea of X-ray inspection fluorscopically of pieces in motion on a production line. With his apparatus, the operator now can "see through" a material or part such as the alloy steel casting, *Fig.* 1, without halting progress through the plant.

The machine, *Fig.* 2, obviates the necessity for making X-ray photographs, a feature that appeals to industrialists who are vitally interested in cutting costs. Where occasion demands, however, photos can be made by a radiograph attachment that is provided.

As the pieces to be inspected pass through the machine on a continuous conveyor belt the operator, looking through an eyepiece, gets an interior view. If flaws are present, as instanced by *Fig.* 1, these are immediately brought to light. A switch located at the operator's left enables him to stop the belt instantly should he wish to study a particular unit more intently through the fluoroscopic screen.

In addition to the examination of aluminum and steel castings, mica and bakelite objects, porcelain and asbestos, welded steel plates, etc., the equipment has been found highly success-

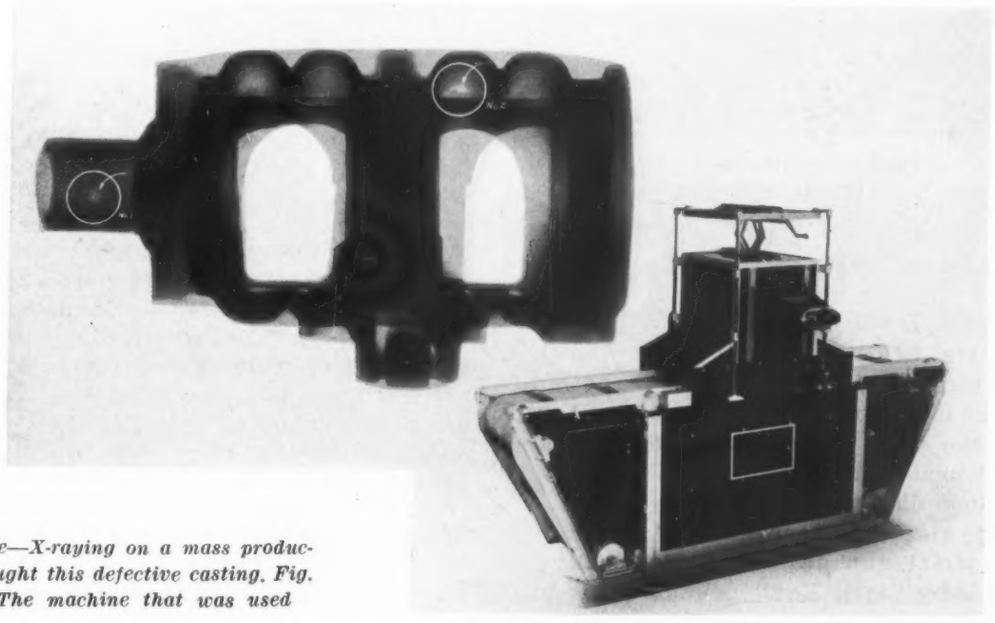


Fig. 1—*Above—X-raying on a mass production basis caught this defective casting. Fig.* 2—*Right—The machine that was used*

ful in the inspection of canned goods on their way to the packing cases.

Although the secondary voltage applied to do the work is of a high rating, it requires only a small consumption of primary current, which means low operating cost. Special tubes are employed and a cooling arrangement has been devised which permits continuous operation.

FORMS REAR RIVET HEAD FROM FRONT

NOW the designer who wants to use rivet construction but finds that one side of the work is inaccessible, can proceed with his original plans. The Huck process, *Fig.* 3, makes feasible many desirable changes in design because it is possible with this development both

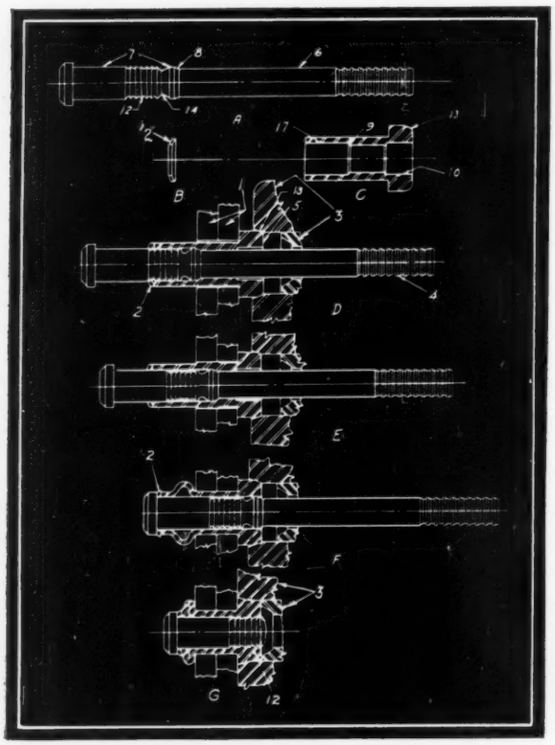


Fig. 3—*Various steps in new riveting process that can be employed when one side of work is inaccessible*

to drive and back up rivets from one side of the work.

Drawings *A, B* and *C* illustrate the three component parts of the rivet, namely the pin, spreader ring and sleeve. Drawing *D* shows the assembly as it is supplied to users. Plates 1, representing the work to be riveted, are provided with 21/64 inch clearance holes for easy ingress of a 5/16 inch diameter rivet.

After the rivet has been inserted in the hole and the special gun developed specifically for this process by Clark Equipment Co., has been applied (see drawing *D* which shows anvil 3 of the gun in position), the operation is ready to proceed. Jaws in the gun automatically engage pull grooves 4 of the pin when either one of two triggers in the handle of the gun is depressed.

An electric-hydraulic pressure unit is employed to actuate the mechanism of the gun, causing the jaws to move away from anvil 3. Angle 13 on the head of sleeve 5 rests against anvil 3 of the gun and takes the entire reaction of the pull on the pin.

The tube end of the sleeve, drawing *C* is counterbored to a larger diameter 17 than the opposite half of the piece. In the assembled rivet, extruding angle 8 rests against shoulder 9 of the sleeve. As the pin is drawn through the smaller diameter hole of the sleeve by the gun, extruding angle 8 spreads the sleeve to fill the clearance in the hole in the work as indicated in sketch *E*.

Further travel of the pin flattens out the spreader ring 2, sketch *F*, thereby increasing its area contact with the sleeve. Continued travel of the pin causes the sleeve to bulb, eventually forming a head which is pulled solidly against the plate. At this point locking grooves 12 on the pin are positioned in the head of the sleeve. As the pull on the pin continues to build up, angle 13 no longer is able to withstand the reaction and gun anvil 3 passes over the head of the sleeve, swaging the material into the locking grooves. Subsequently the pin is broken in tension at groove 14, completing the riveting process as shown in *G, Fig.* 3. The entire cycle is completed in less than one second.

KNOW YOUR FINISH PROCESSES!

HAVE you heard about the new electroplating process that deposits a bright zinc surface on steel? It was announced recently by E. I. du Pont de Nemours & Co., and is said to be the first time a bright plating of zinc has been commercially possible. Good corrosion resistance is imparted by the process. Applications include a wide variety of machine parts such as steel stampings, bolts, nuts, screws, chains, etc., used in the auto, radio, airplane, household equipment and other fields. The process is expected to find wide use in those industries requiring economical production of decorated surfaces with good corrosion resistance on steel parts.

Then there is a new Jetal process for placing on metal surfaces a lustrous black finish which will not scratch, chip, peel, scale or discolor. This material also is being used on iron and steel to form a bond for enamels, lacquers, japan and other baked finishes, this because it is not affected by high temperatures. Alrose Chemical Co. is announcing the process.

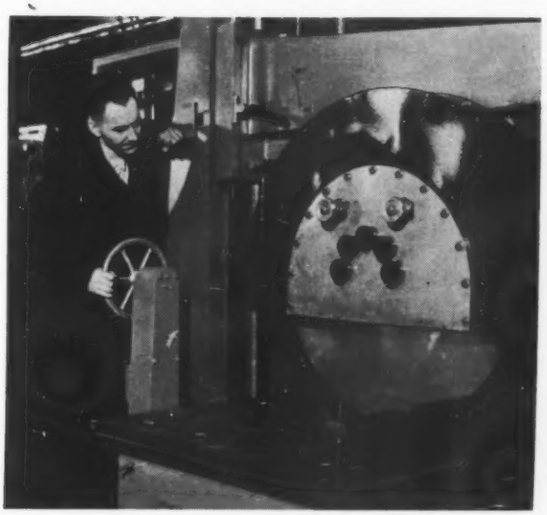


Fig. 1 — Inventor Karl Strobel puts his new electric arc saw in operation for metal show visitors. The toothed circular blade virtually melts its way through the work

Materials and Ideas

Vie for Prominence at Metal Show

JUST as the array of exhibits at the recent Metal Show in Chicago was indicative of the spirit of recovery so did it also reveal a healthy increase in ideas, both in metal application and in general design. Particularly were engineers attracted by the Strobel electric arc saw, *Fig.* 1. Cutting principle of the unit is based on the displacement of molten metal by a circular toothed blade. This saw blade, of soft alloy steel, does no actual cutting but acts as an electrode carrying the low voltage, high amperage current. Serving as the other pole is the table which carries the work piece to be cut.

During the cutting process the controlled electric arc leaps ahead of the saw teeth and brings the metal to a molten or plastic state, the toothed blade subsequently sweeping the melted material from the kerf. The arc travels in a path but a few thousandths of an inch wider than the blade. A smooth surface is obtained on the cut edges.

Another device that bespeaks design progress and to which considerable attention was directed, was a new system of automatic temperature control. It embodies a unique principle based upon electronic tube action, never before applied to pyrometric control.

Designers also found much profitable information in discussions conducted by the various societies participating in the congress. In a comprehensive paper on low alloy high tensile steels, A. E. Gibson, vice president, Wellman Engineering Co., Cleveland, said before the American Welding society: "To those unfamiliar with low alloy steels it will be of interest that high physical values are obtained in most instances with low carbon content. This condition is ideal for welding as it eliminates almost entirely the objectionable air hardening experienced in welding steels of the higher carbon range."

Lauds Torch Cut Machine Parts

The cutting torch has freed the designer from many limitations due to materials used and in some cases has made possible construction that never could have been considered from a foundry standpoint, P. H. Danly declared in his discourse on "Fabricating Tool Equipment and Machine Parts by the Torch Cut and Weld Method."

This year the metals exhibit was considerably larger, floor space occupied representing a fifty per cent increase over the 1934 New York show. More than two hundred companies exhibited. Various uses of a wide range of metals and alloys were shown, among them many machine parts characterized by such properties as corrosion and heat resistance, light weight, strength and ductility. Reference to corrosion resistance brings to mind the display of machine parts protected against corrosion by a single continuous coating of 99 per cent lead, a patented process.

Determining the Effect of

By John S. Carpenter

ROTATING masses offer resistance to starting or stopping because of their inertia, and careful investigation of this inertia is extremely important in design. A simplified means of determination is presented herewith.

The moment of inertia is the product of two factors — the mass and the square of the radius of gyration. Let I be the moment of inertia, W, weight in lbs., g, gravity constant, 32.2 ft. sec.^{2}, and R, radius of gyration in feet, then

$$I = WR^2/g \quad \ldots\ldots (1)$$

It is evident that I varies most by varying R, since R appears as the square.

Any change of driving torque T required or given out by a rotating mass arises from a change of velocity at radius R. Therefore at constant speed there is no change of torque.

The torque T in pounds at 1 foot radius required for a given horsepower P and revolutions per minute N is

$$T = 5250\,P/N = 550\,P/w = Iw \quad \ldots\ldots (2)$$

where w is the angular velocity in radians per second and is equal to $0.1047N$.

The work E in foot pounds required to accelerate a rotating mass from an initial angular velocity w_1 to a final value w_2, not counting bearing friction and windage, is

$$E = (\tfrac{1}{2})I(w_2^2 - w_1^2) = (\tfrac{1}{2})W/g \times (v_2^2 - v_1^2) = WR^2 \times (N_2^2 - N_1^2)/5870 \quad \ldots\ldots (3)$$

where v_1 and v_2 are the initial and final velocities at the radius of gyration in foot seconds. The same amount of work, less bearing friction and windage, is given out when decelerating from the initial values w and v to their final values.

In practice we meet three principal cases of rotating mass-load combinations. Commercial machines usually consist of more than one of these cases in varying proportions. These are: (a) Constant torque independent of speed; (b) torque varying linearly with speed; and (c) torque varying as the square of the speed.

Case (a) consists of most types of reciprocating machines. Case (b) includes belt and chain conveyors and machines having high bearing friction. Case (c) includes fans, blowers, centrifugal pumps and turbo-compressors, etc. *Fig.* 1, *a*, *b* and *c* show these relations graphically. Some types of (c) will have the power varying as much as 4.5 power of the speed, particularly at off-peak speeds.

Torques Must Be Added

The torque required to accelerate rotating masses must be added to that required by the work done. In some cases this has not been appreciated by designers, hence burned out motors or pulling out of step.

At no place along the speed range should the driving torque be exceeded by the torque required for the driven machine. An intelligent selection of driving motor or engine is not possible without a knowledge of the two torque curves, driver and driven. *Fig.* 2 shows the curves of typical induction motor torque, reduced to straight line combination to simplify computations.

It is often required to compute the time in which rotating masses will come to rest with-

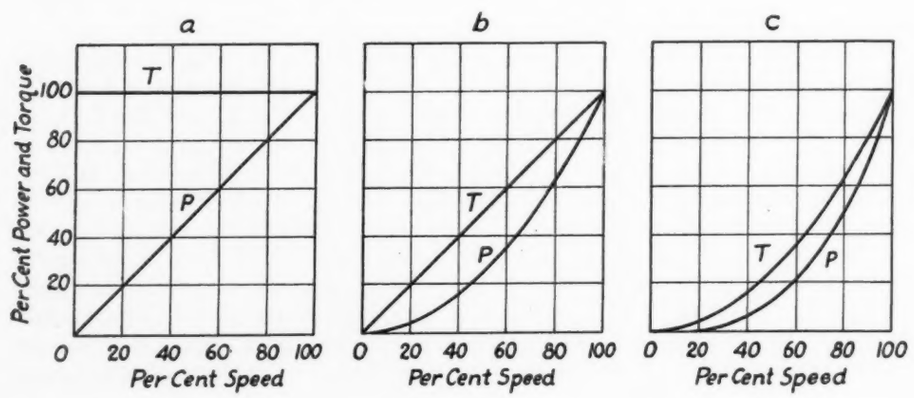


Fig. 1—Mass-load relationships govern steps followed in the design

Rotating Masses

out braking, due to the mechanical work done in the interval. *Fig.* 3 shows a power-speed curve while decelerating from an initial RPM to zero RPM. The cross-hatched element of work done is

$$dE = y\,dx = 550\,P\,dt \text{ ft. lbs.}$$

The area under the curve may be stated in terms of foot-pounds-seconds and is equated to the third member of equation (3)

$$E = 550 \int_{t=0}^{t=t} P\,dt = P_m t = WR^2N^2/5870 \quad \text{.....(4)}$$

in which E is energy in foot pounds seconds and P_m is the mean ordinate in *Fig.* 3. By calculus methods, values of P_m for the various loads cited are: (a) Power varying as first power of the speed, P_m is 0.50 P max.; (b) Power varying as square of the speed, P_m is 0.333 P max.; and (c) Power varying as the cube of the speed, P_m is 0.250 P maximum. t then is

$$t = WR^2N^2/3{,}230{,}000\,P_m \text{ seconds} \quad \text{.....(5)}$$

For some types of loads it may be necessary to find P_m by either planimeter or Simpson's Rule.

The value of t found by equation (5) will usually be accurate enough for practical purposes. It is not exact, however, as the assumed laws do not hold throughout the speed range.

In many cases it is desirable to find the value of R, the radius of gyration, by shop test. This is especially true of rotating masses of complicated shape. See *Fig.* 4. If the casting or assembly be hung on knife edges the axis about which R is required must swing parallel to the axis through the knife edges. Swing the assembly so it will make, say, 100 complete back and forth movements or complete oscillations. The time can then be observed with an ordinary watch, giving a high degree of accuracy for the time of one complete oscillation.

The radius of gyration of the assembly, about the axis of the knife edges, is then

$$K = \frac{T}{2\pi}(32.2\,D)^{1/2} \text{ feet} \quad \text{.....(6)}$$

where T is the time of one complete oscillation and D is the distance in feet from the knife edges to the center line of the assembly. The distance D should be measured very carefully in inches and decimals of an inch. Conversion into feet is desirable for accuracy, as the final answer depends upon the difference of two squares.

R then is

$$R = (K^2 - D^2)^{1/2} \text{ feet} \quad \text{.....(7)}$$

Having the WR^2 of one size machine or assembly, the WR^2 of other sizes of a homologous family will vary from the 4.5 to the 5 power of the rated diameter or radius, according to whether the thickness varies as the ratio of

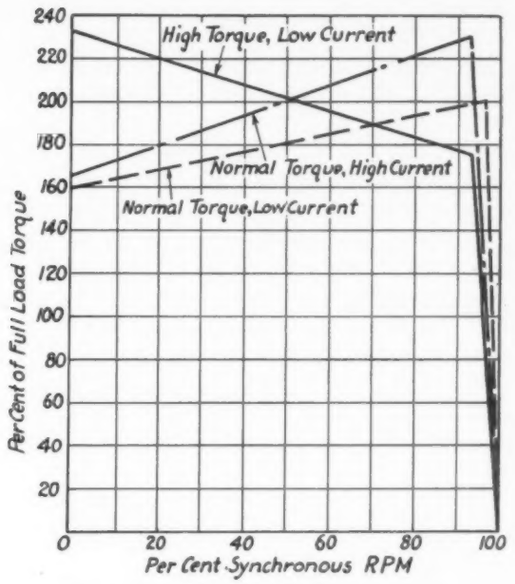
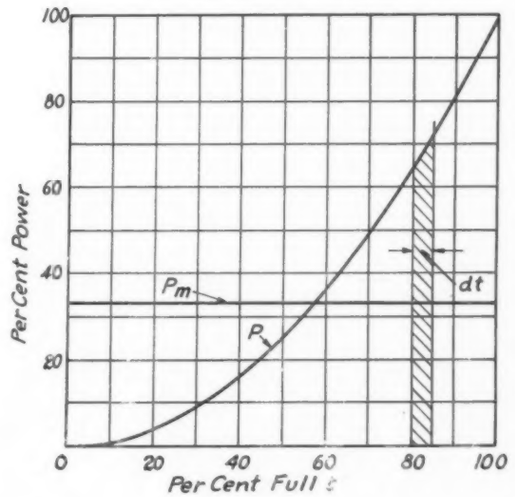


Fig. 2—Intelligent selection of motor is not possible without knowledge of torque curves such as these

Fig. 3—Work done by a rotating mass as it comes to rest is indicated by cross-hatched section



the square roots of the sizes or linearly with the sizes.

In all machines where the torque changes during a revolution or cycle of operation, it is usual to supply flywheel effect in some form to store up energy during the lighter-loaded portions of the cycle and supply energy from the rotating masses during the heavier-loaded part.

Fig. 5 shows a demanded load curve expressed in horsepower and seconds. Let the initial and final horsepowers be N_1 and N_2, the initial and final RPMs be n_1 and n_2, and the time of the demanded load cycle be t seconds.

The deficient power is represented by the cross-sectioned area. If the load line is parabolic, as it often is, then E, the deficient energy is

$$E = 0.666\,t(N_2 - N_1) = 0.666\,t\,N,\ \textit{horsepower seconds} \quad (8)$$

This is to be equated to the energy to be given out by the rotating masses with a resulting speed drop $n_1 - n_2$.

The total energy in the rotating masses is:

$$E = WR^2(n_1^2 - n_2^2)/5870 \times 550 = 0.666\,tN,\ \textit{horsepower seconds} \quad (9)$$

for demanded load, the speed relation is:

$$n_1^2 - n_2^2 = 0.666 \times 5870 \times 550\ \ tN/WR^2 = 3{,}230{,}000 \times FtN/WR^2 \quad (10)$$

where F is the mean ordinate of the cross-sectioned area.

For a parabolic load curve as shown	F is 0.666
For a straight-line load curve	F is 0.500
For an inverted parabolic curve	F is 0.333
For suddenly applied load of constant value	F is 1.000

These values will cover the range usually found.

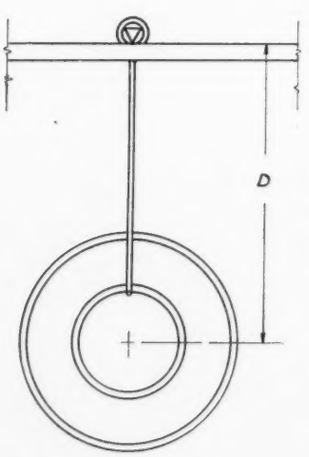


Fig. 4—Typical shop test employed to determine the radius of gyration of an important machine part

If the difference $n_1 - n_2$ is small, then

$$n_2 = n_1(1 - d)$$

where d is the drop in speed, expressed as a decimal. Squaring the binomial and reducing,

$$-d = 1{,}615{,}000\,FtN/WR^2n_1^2 \quad (11)$$

when d is large compared to unity, equation (11) is not accurate and then equation (10) should be used. The minus sign refers to a drop.

In the general case, we can solve directly for the WR^2 required, using equation (10) by

$$WR^2 = 3{,}230{,}000\,FtN/n_1^2 - n_2^2,\ \textit{foot square pounds} \quad (12)$$

which gives the required weight at one foot radius, and the weight at any other radius is

$$\textit{Weight at } R \textit{ ft. radius} = WR^2/R^2$$

where R is the radius of gyration. The value of R^2 for a flywheel rim is

$$R^2 = (\tfrac{1}{2})(R_o^2 + R_i^2)$$

o and i refer to outside and inside R. Usually, flywheels have spoked centers, therefore the WR^2 of the spokes is very small compared to that of the rim and is usually not counted in the calculation unless the flywheel is of large size. If, however, a disk center is used, R^2 is very closely one-half the square of the outside radius in feet.

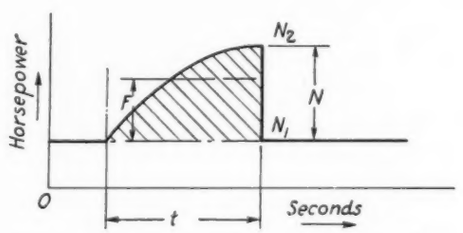


Fig. 5—Demanded load curve is expressed in horsepower and seconds

If w is the weight of the material used, per cubic inch, the volume, V, of the metal in the rim is

$$V = WR^2/R^2w,\ \textit{cubic inches}$$

The outside diameter of the flywheel will be governed by permissible peripheral speeds as well as constructional limitations. For cast iron, flywheels should not exceed 100 feet per second at the maximum speed, based on the outside diameter. Cast steel flywheels may have values from 275 to 350 feet per second, the latter with a solid disk center, well filletted. A compromise construction consists of a cast iron flywheel with a steel band shrunk on the outside, the radial depth being from 35 to 40 per cent of the total radial depth of the rim. This permits peripheral speeds up to 150 feet per second.

In conclusion, it should be noted that a design based on demanded load will not necessarily be sufficient. The flywheel must have time to regain its former initial speed before another cycle of operation can begin. The time required will depend on the size motor or other prime mover driving the machine. If, however, the intervening energy supplied is equal to the demanded energy for the cycle, the rotating masses will just return to initial speed. Some margin should be allowed for detention by friction.

Suspension Linkage Prevents Bearing Wear in Mine Scale

By M. E. Holmes
Toledo Scale Co.

IF IT were possible, the even balance principle of weighing might be used universally. This principle would provide for determining weight by counterbalancing with an equal load, but because of the extremely heavy loads which must be weighed this is not a practical method. Therefore, the use of multiplying levers and relatively light counterbalancing mechanisms has become universally adopted in industrial weighing.

In *Fig.* 1 is illustrated an automatic scale designed for weighing loaded mine cars. By means of a series of multiplying levers and an indicating mechanism the loaded car weight is automatically and instantly indicated on a reading dial. Such reading dials may be calibrated with practically any desirable graduations consistent with the class of service for which the scale is used.

The general scheme of the main lever system is depicted in *Fig.* 2. For continuously accurate weighing the system must be designed and constructed not only to withstand the dead weight of the mine car loads but also the impact and all lateral motion of the weigh bridge and loaded mine car when the car strikes the live railroad rails and passes on the scale lever system. Such loading of scales necessarily causes an uneven distribution of forces and control of this impact and lateral motion is of extreme importance.

Control of the impact and lateral motion prevents a grinding and wearing action between pivots *B* and bearings *C* shown in *Figs.* 3 and 4. This

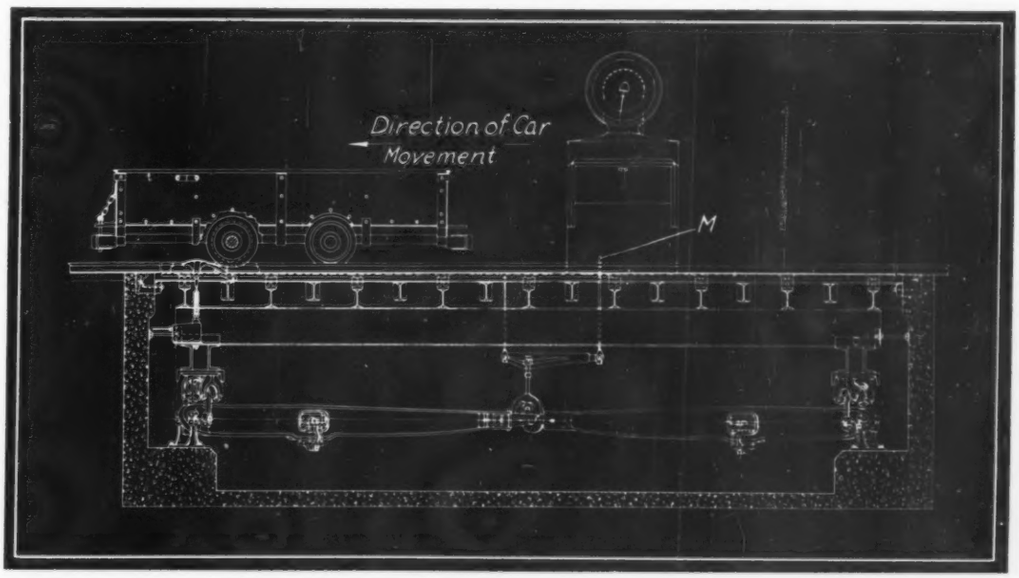


Fig. 1—*A series of multiplying levers and an indicating mechanism are embodied in scale for weighing loaded mine cars*

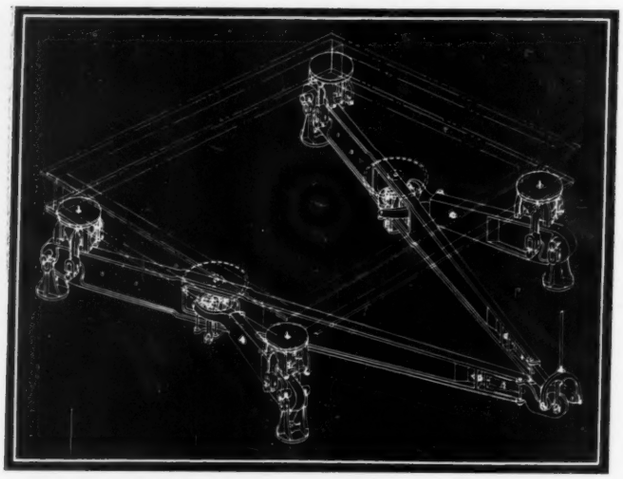


Fig. 2—General scheme of the main lever system designed to withstand dead weight and impact loads

control is imperative since any dulling of the knife edges of the pivots would impair the accuracy of the scale and decrease its sensitiveness. When scale lever systems are designed in accordance with the construction, illustrated, the vital pivots and bearings are protected through the use of suspension bearing assemblies *D* and *E*. These assemblies are interposed between weigh bridge *J* and main lever *K* to absorb the shocks to which the scale is subjected as the loaded car rolls on the lever system.

Rocking of Bearings Prevented

With the weigh bridge and live rails in the normal position the links of the suspension bearing assemblies hang plumb. As the weigh bridge swings from its normal position in either direction, the links swing as shown in *Figs.* 3 and 4. The points of link suspensions *G* and *H* are located to permit this movement. As soon as the lateral forces are removed from the weigh bridge the links return to their own centers of gravity and allow the weigh bridge to return to its normal position. It will be observed in these drawings that although the suspension bearing links are out of plumb, the yoke *F* remains in a vertical position. As a result there is no rocking of bearings *C* on the knife edges of pivots *B* when the weigh bridge oscillates.

The heavy pivots used are of tool steel, heat-treated and accurately ground. They are gripped in tapered steel pivot retainers that fit tightly into the levers. Pivot bearings are self-aligning, interchangeable and compensating, insuring uniform contact of the knife edge throughout the full length of the pivot and its opposing bearing.

Main levers *K* cannot move with the weigh bridge, being mounted on rigid fulcrum stands *L* (*Figs.* 3 and 4). Such lever systems as illustrated require only four fulcrum stands and four suspension bearing assemblies as shown in *Fig.* 2. This simplified design minimizes the possibility of lever connections getting out of plumb and since the fulcrum stand locations are at the corner of a perfect rectangle, accurate location of fulcrum stands is a simple job at the time of installation. The number of friction points is reduced to a minimum. Pivot lines in all levers are in a straight line and at the same elevation, another feature of design essential to insure accuracy.

To improve the efficiency of this type of Toledo scale still further, the designers have provided a so-called "dead deck and live rail construction." Only the rails on which the mine car

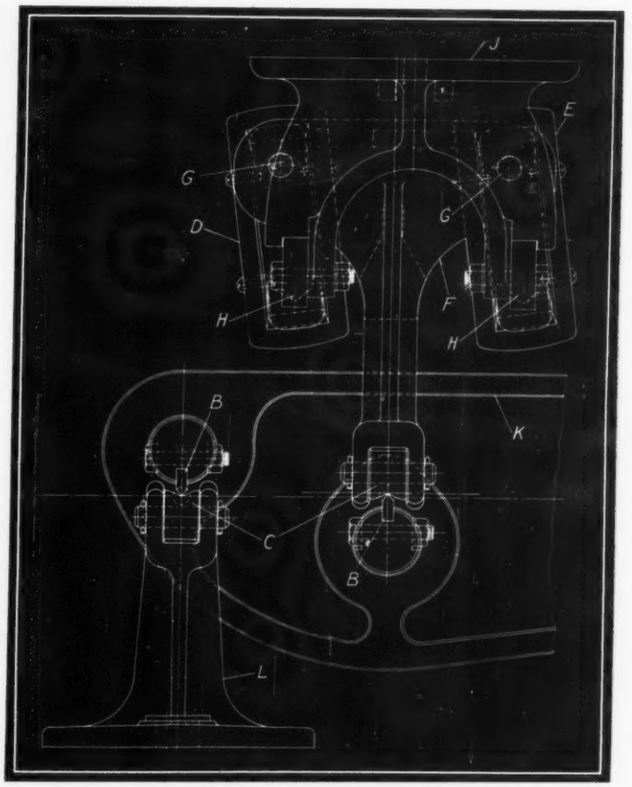


Fig. 3—Suspension bearing assemblies absorb the shocks to which the scale is subjected as the loaded mine car rolls on the lever system

rolls receive the loads and transmit the force to the weighing mechanism, thus making it unnecessary to consider coal or other material that may drop on the dead deck.

All Steel Cabinet Employed

The force of the load applied to the rails and the consequent transmission of this force through the lever system actuates steelyard rod *M, Fig.* 1, connected with the dial recording system. The dial or indicating mechanism is mounted in an all steel cabinet which houses the tare and capacity beams. Provision has been

made in the design of the indicating mechanism for automatic counterbalancing by means of heavy double compensating pendulums. The housing for the pendulums and indicating mechanism is protected from dust and moisture by means of rubber gaskets between the front or back scrolls and the housing.

An ingenious oil seal is provided at the point where the steelyard rod passes into the dial housing, effectively preventing dust and moisture from entering at that point. The oil seal consists of a lower cup which contains the oil and is fitted in the dial housing casting. An upper inverted cup is fastened to and moves up and down with the steelyard rod. This steelyard rod moves with the weighing mechanism. Lower part of the inverted cup always is immersed in the oil. The tubular opening in the lower oil cup affords free passage of the steelyard rod and thus moisture, acids, fumes and dust cannot enter the dial housing around the steelyard rod of the scale.

Bimetal Utilized in Dashpot

When this type scale is used in the mining industry, it is almost always used in conjunction with a weight printing device that affords a complete accounting unit, eliminating the possibility of error in reading the dial or incorrectly writing down by hand the weight record. For automatic operation of the weight printer while the car is in motion, it is necessary that the weigh bridge and live rails be approximately 12 to 14 feet long so that all wheels of the mine car are actually on the scale from three to four seconds before the weight is printed. In that length of time a hydraulic automatic dash pot, *Fig.* 5, brings the dial indicator and printing disk to rest for proper recording of the weight. The hydraulic dash pot embodies an interesting application of bimetal as shown at *N*. This mechanism automatically controls the orifice in the plunger to compensate for changing viscosity of the oil due to temperature fluctuations in the surrounding atmosphere.

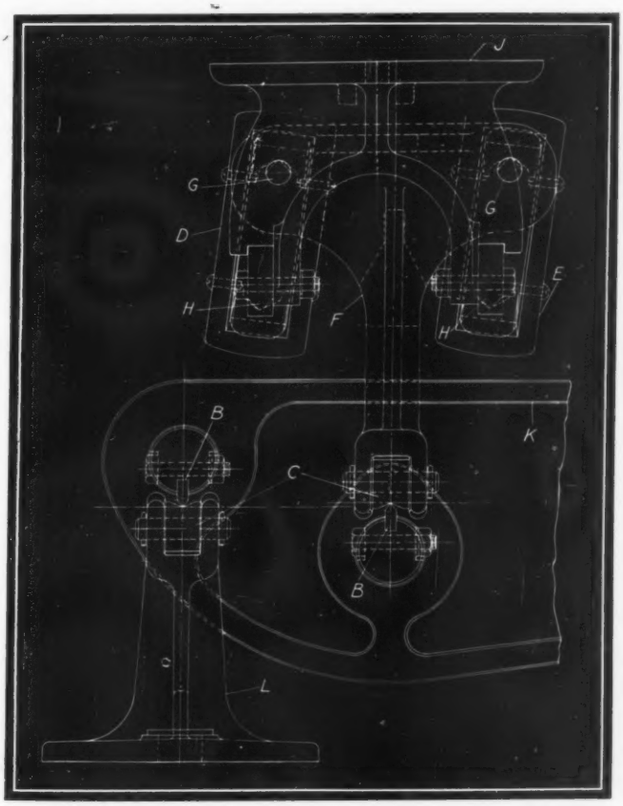


Fig. 4—Although the suspension bearing links are out of plumb the yoke remains in a vertical position, with the result that there is no rocking of the bearings on the knife edges of the pivots to cause wear

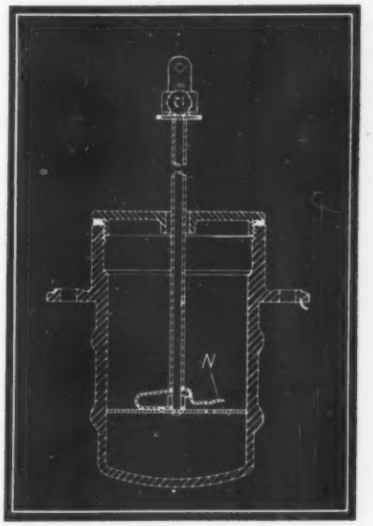


Fig. 5—Dashpot employed to bring dial indicator and printing disk to rest for proper recording of weight. This device embodies a strip of bimetal which automatically controls the orifice in plunger to compensate for changes in oil viscosity

Device Provides Printed Record

The selective numbering device of the Printweigh system consists of a keyboard arrangement attached to the printing unit. This is designed with suitable numbers and letters to identify any particular weighing operation. This mechanism indicates the hour of the day the loaded train arrives at the tipple, the mine location where each car was loaded, the number of cars in the trip, the miner's check number, and the net weight of the loaded car (tare weight of the car is offset by means of the capacity and tare beams).

The weighman on duty sets up the miner's check number on the keyboard just before the mine car reaches the weigh bridge and live rails. Weight and weight identification are automatically printed when the car wheels depress a trigger just before the car starts to leave the scale. Operation of automatic recording is accomplished in less than a tenth of a second. Thus designers have employed their ingenuity again to produce an accurate and foolproof unit.

Universal Nomogram Eliminates N

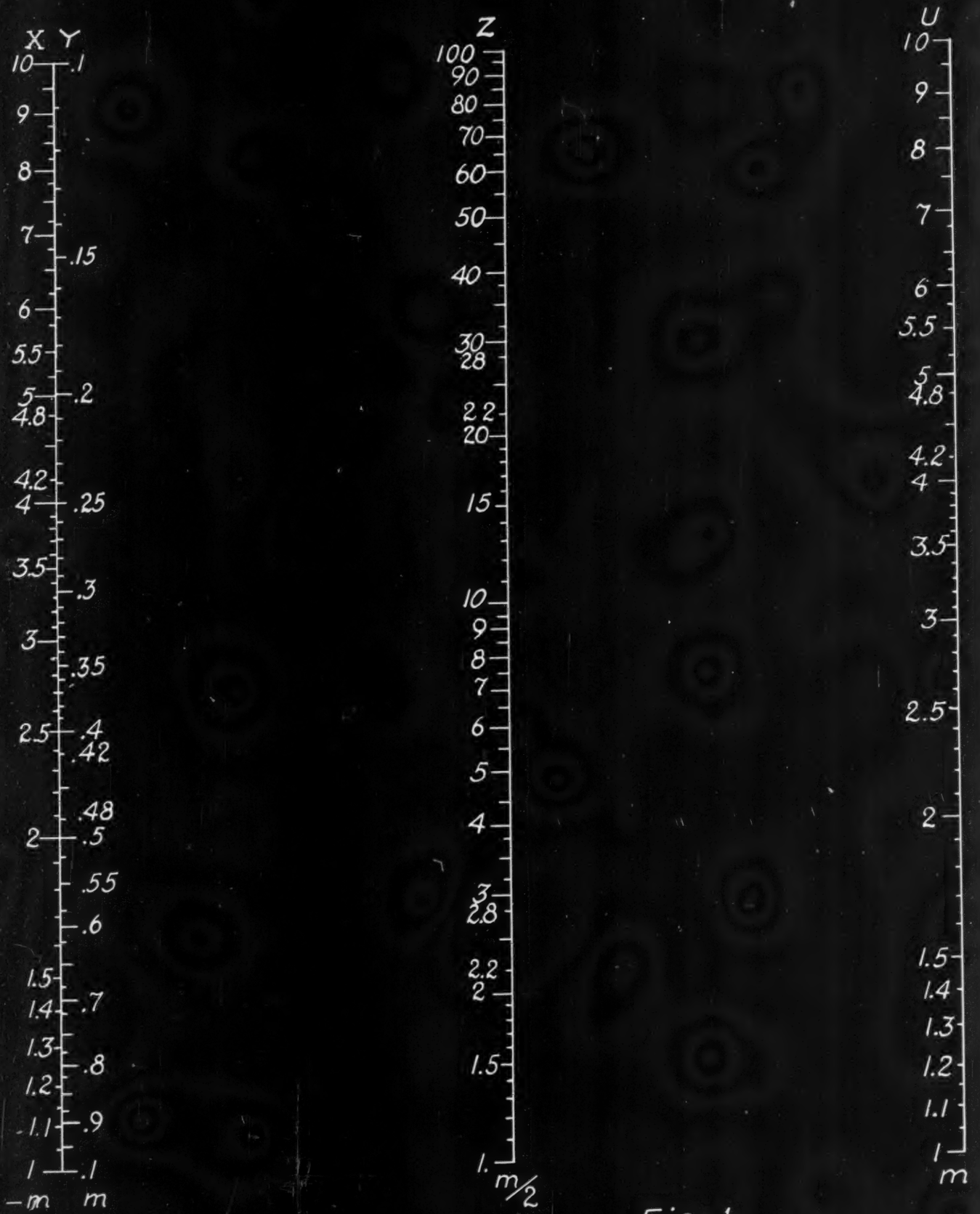


Fig. 1

Needless Work

By Carl P. Nachod
Vice President, Nachod & U. S. Signal Co.

WHEN the three parallel scales of an ordinary nomogram for evaluating a particular equation containing three variables are cut by any index line or secant, the secant shows the three values that satisfy the equation. Each of the scales, however, must be used for its own variable, so that different equations therefore require separate nomograms. The writer proposes a universal nomogram, *Fig.* 1, so that any equation consisting of products, squares and square roots may be solved by it. With this, it must be known on what scale to lay each variable, which can best be done by reference to forms. These are herein derived and tabulated.

For instance, an equation of the form $a=bcd(e)/f$ is classified as 6-4 because it has six variables or quantities, which, when solved for one of the variables, has four quantities in the numerator of the other term. Any one of the quantities in this term may be a constant, and any variable may represent a square or a square root. The parenthesis around (e) indicates it is to be laid on the inverse or Y scale. Thus *Fig.* 6 is a paradigm or model to show on what scales to lay the quantities for an equation of the form 6-4. If any of the variables b, c, d, etc. are squares and square roots, then *Fig.* 2 is the model for finding these values independently to insert in the 6-4 equation.

Employs Parallel Scales

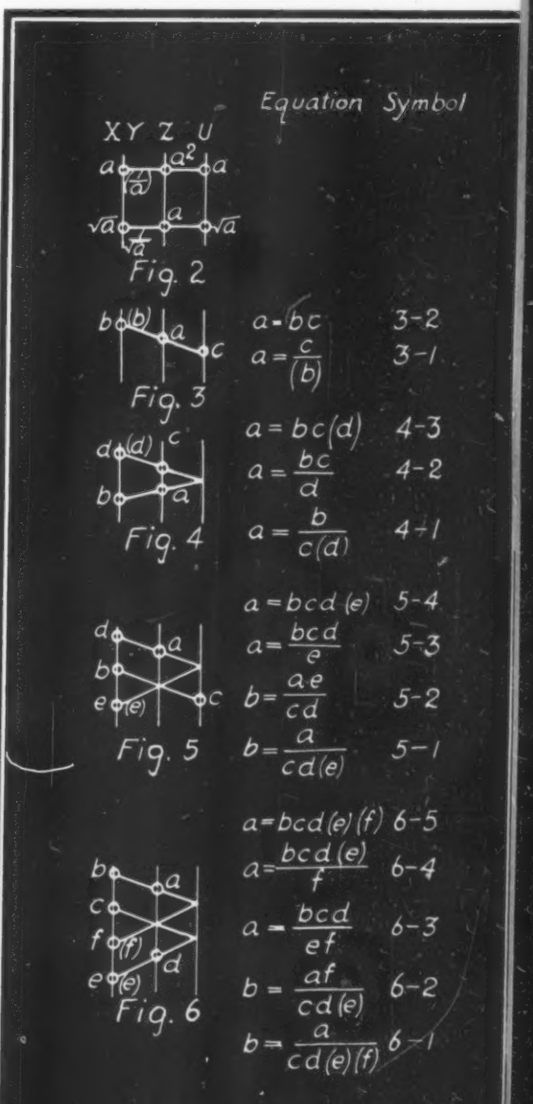
The nomogram *Fig.* 1 is constructed of three parallel equidistant scales X, Z and U, graduated logarithmically, starting at the perpendicular bottom line, such that the length from 1 to 10 (the modulus) on the inner Z scale is one-half that on the outer scales, X and U. Also, the left scale X is doubly graduated in comparison with the scale on the right of the same line, Y, which has the same modulus, but starts with 1 at the bottom and decreases upwards in an opposite manner to the other scales. That is to say, the moduli of all the scales from left to right are: m, $-m$, $m/2$, and m for X, Y, Z and U respectively.

Then any number on the Y scale is the inverse of the number on the X scale at the same point, so that $x=1/y$ if the small letters represent the numbers cut on the respective scales. Also, by the theory of nomograms, any secant cutting X, Z and U cuts out values on these scales satisfying the equation $z=xu$. This chart therefore represents the multiplication table (proper attention being paid to the decimal point), the two factors being on the outside scales, and the product on the middle scale, as is shown in *Fig.* 3 for equation 3-2.

In the eq. $z=xu$, if $x=u$, then $z=u^2$; that is, if the numbers on the outer scales are equal, then the secant through them cuts the middle scale at the square of the number. This secant will be perpendicular to the scales and parallel to the base line; conversely, of course, for the square root, all as shown in *Fig.* 2.

To derive *Fig.* 4, the equations of the two secants drawn to form a V are $du=c$ and $bu=a$, calling u the number on the U scale common to both, or the point of the V. Hence, eliminating u from these equations, we have $d/b=c/a$ or $a=bc/d$ which is eq. 4-2, as the equation solved by the V secants. Here d and a may be interchanged on the scales, as well as c and b. If d is laid on the Y scale, which is the inverse scale, it will appear in the *numerator*, or $a=bc(d)$ which is eq. 4-3.

To derive *Fig.* 6, calling z the unmarked intersection of the two V's on Z, we have, by *Fig.* 4, $b/f=a/z$



and $c/e=z/d$. Eliminating z between these, $a=bcd/ef$ which is 6-3. In a similar manner the equations represented by *Fig.* 5 are derived, and this process might be continued for equations involving more than the six quantities shown.

Factors May Be Transposed

Figs. 4, 5 and 6 are susceptible of certain transpositions. For instance, it is self evident that, in *Fig.* 3, b and c may be transposed on their respective scales, although in this case there is nothing gained by so doing. However (b) and c may *not* be transposed.

Since, if $a/b=c/d$ then $a/c=b/d$, in *Fig.* 4, b and c may be transposed; also a and d, but not a and (d). In *Fig.* 6, a and f, also c and d may be transposed respectively. These transpositions will often make a better position of the secants so that they remain on the scales.

Typical Solutions Indicated

Fig. 7 shows the calculation of three formulas, *Fig.* 8 shows two, and *Fig.* 9, two. All are illustrative formulas taken at random with such values as will permit more than one on the chart without overlapping. *Fig.* 7, upper, figures the distance S feet covered by a freely falling body in t seconds from the equation $S=16.08\ t^2$ and shows that it falls 825 feet in 7.15 seconds. The quantity t^2 is figured from t by secant I using *Fig.* 2. In the form $t^2=S/16.08$ it typifies eq. 3-1 $a=c/(b)$ with t^2 as a on Z, the constant 16.08 as (b) on Y, whence secant II through these points cuts out S as c on U. *Fig.* 7, middle, exemplifies eq. 3-2, showing that the circumference of a circle 5.2 inches diameter is 16.3 inches. *Fig.* 7, lower, typifies eq. 4-2, as $e=WV^2/450{,}000$ in which secant I figures v^2 from *Fig.* 2, e is a, w is b, v^2 is c and 450,000 is d; and it shows that a bullet weighing 180 grains, moving at 2650 feet per second has a striking energy of 2800 foot-pounds. In *Figs.* 7, 8 and 9 the secants are to be drawn in the order marked (with Roman figures.)

Fig. 8, upper, figures the well known horsepower formula for a single cylinder, single-acting steam engine. It illustrates eq. 6-4. $H=PLAN/33{,}000$, $a=bcd(e)/f$. In this, H is a, P is b, etc. according to the corresponding positions.

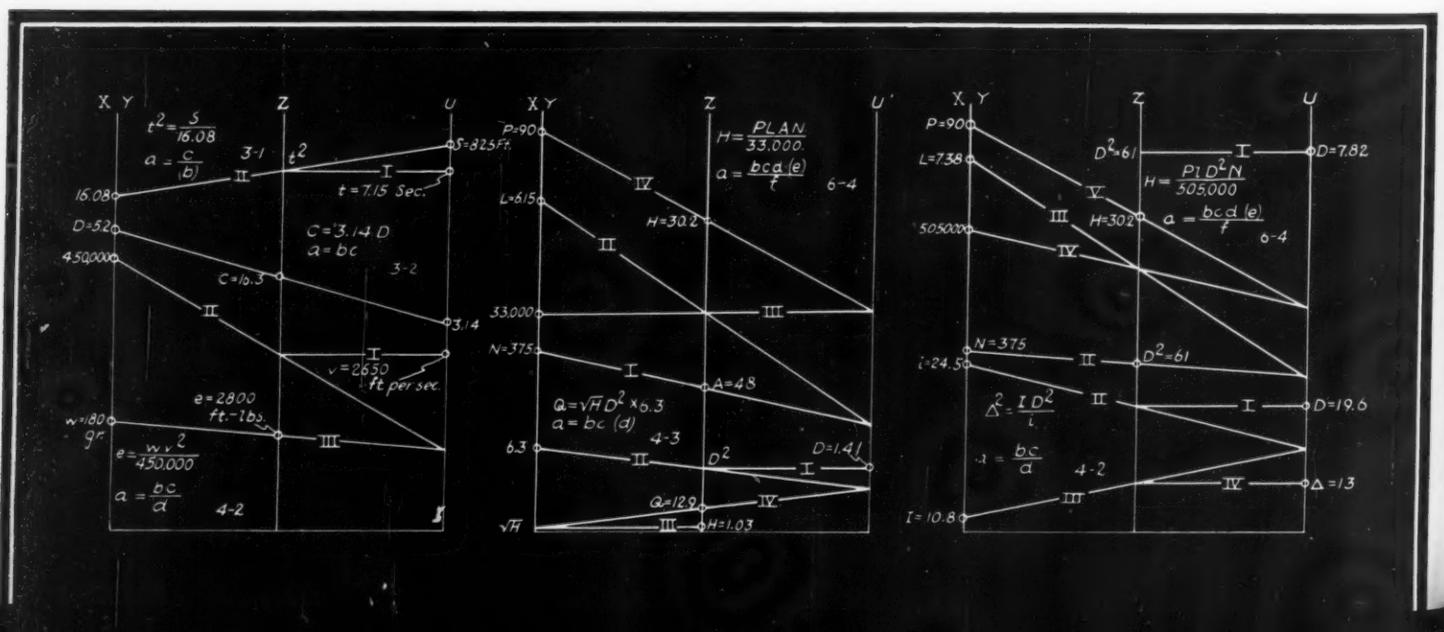
Solves Hydraulic Formula

Fig. 8, lower, shows by a hydraulic formula that 12.9 cubic feet of water per second flows through a pipe 1.41 feet diameter under a hydraulic head of 1.03 feet, by the use of eq. 4-3, and by *Fig.* 2.

Fig. 9, top, computes the foregoing horsepower formula in a more convenient form where the stroke is given in inches, instead of feet; and the diameter, instead of area of piston is given. It uses eq. 6-4. It will be noted that although $D^2=61$ by *Fig.* 2, if 61 is used on Z, the secants will cut beyond the graduated scale, and therefore 6.1 for D^2 is used instead.

Where the secant, as sometimes happens, cuts a short distance beyond the graduations, say at the *top,* it may be brought back by offsetting the excess from the *bottom* of the scale, or if it cuts beyond at the *bottom,* by offsetting the excess from the *top.* This is equivalent to dividing or multiplying by 10. The nomogram will always give consistent results if the quantities used are those of the scales, but if the quantities are multiplied or divided by 10, 100, etc., as is usual, the result must be properly pointed off to correspond. However, in most engineering calcula-

Fig. 7—(Left)—Formulas involving the use of squares employ the step shown in Fig. 2. Fig. 8—(Center)—Auxiliary points enable the solution of formulas with five variables. Fig. 9—(Right)—Sequence of steps is shown by the use of Roman numerals on the secants



tions the order of magnitude is approximately known.

Bottom of *Fig.* 9 shows by eq. 4-2 that, if a surface 19.6 feet distant from a light source receives an intensity of 10.8 foot-candles, then when moved 13 feet from the light, it will receive 24.5 foot-candles. This is because the intensity of illumination in foot-candles on a surface varies inversely as the square of the distance from the light source.

System of Secants Is Consistent

Figs. 4, 5 and 6 therefore show a consistent system of secants, these being made by *V's* with their points on the *U* scale and having intersections on the *Z* scale with successive *V's*. Other systems may be used, as with *X's* for units inter-

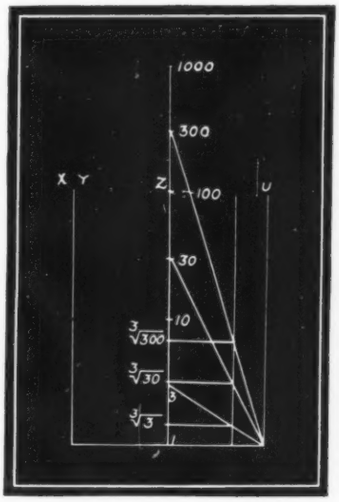


Fig. 10—Perpendiculars erected from the base line as shown aid in the determination of cubes and cube roots

secting on the *Z* scale, which has the advantage of using the *X* and *U* scales, these being more open than the *Z* scale, but the secants will more likely cut beyond the scales. The point of the *V* may also be on the *X* scale, though this is a disadvantage.

Solves for Cubes

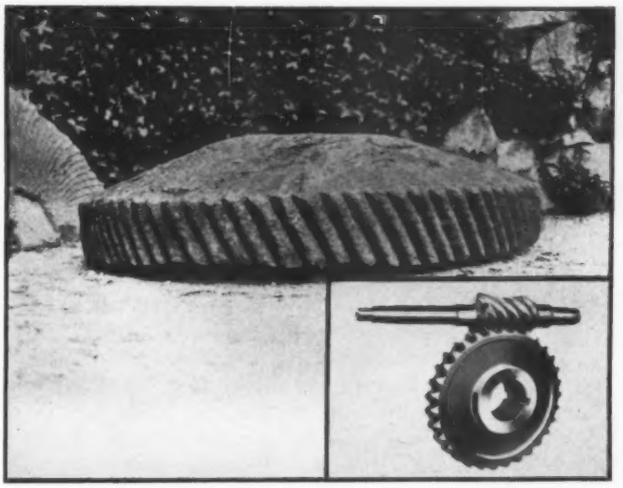
The nomogram may easily be extended for cubes and cube roots; and for 4th powers and roots. For the 4th power is the square of the square, and the 4th root the square root of the square root. This means merely using *Fig.* 2 twice. For cube roots, since, by the theory of logarithms, the cube root of three will be 1/3 the length of the scale up to the number 3, we need merely trisect this length, preferably on the *Z* scale, since this is two moduli in length. The easiest way to do this is by erecting a perpendicular to the base at a distance from *U* one-third the distance between *U* and *Z*, as shown in *Fig.* 10. A radius drawn through the foot of *U* will give $\sqrt[3]{3}$ and through 30 will give $\sqrt[3]{30}$, but for $\sqrt[3]{300}$ it will be necessary to extend the *Z* scale another modulus. Or since $\sqrt[3]{30}=\sqrt[3]{3}\times\sqrt[3]{10}$ and $\sqrt[3]{300}=\sqrt[3]{3}\times\sqrt[3]{100}$, all cube roots may be obtained as these products without extending the scale, the values of $\sqrt[3]{10}$ and $\sqrt[3]{100}$ being marked on the scale for convenience.

To find the cube of 9.1, which is merely 3 times the scale length up to that number, this comes into the extended *Z* scale; or if it is not graduated, set off the excess from the foot of the *Z* scale. Marks made on the edge of a sheet of paper may be used for setting off.

The above explanation should enable anyone to compute a particular formula with this nomogram.

Present Practice Anticipated by Ancient Swedish Gear

A HELICAL gear cut out of solid stone some eight or nine centuries ago, bearing a striking resemblance to present-day helical gears, has been discovered in the ruins of an old castle in Sweden by Otto Lundell, president, Michigan



A startlingly clear conception of gear design for the period is shown by ancient Swedish gear

Tool Co. It is quite likely that the gear was one of a gear train used to drive a community grain crusher. Although the gear has outlived any definite records of the use to which it was put, it it shows a startlingly clear conception of gear design for so ancient a period. The gear is thicker at the hub than at the teeth to provide adequate bearing area.

At the right of illustration is shown, for comparison, the Cone "area contact" worm gear, which, it might be when said judging from the stone gear, incorporates the most up-to-date principles in the science of gearing.

Utility Plus Appearance

By Herbert Rosengren

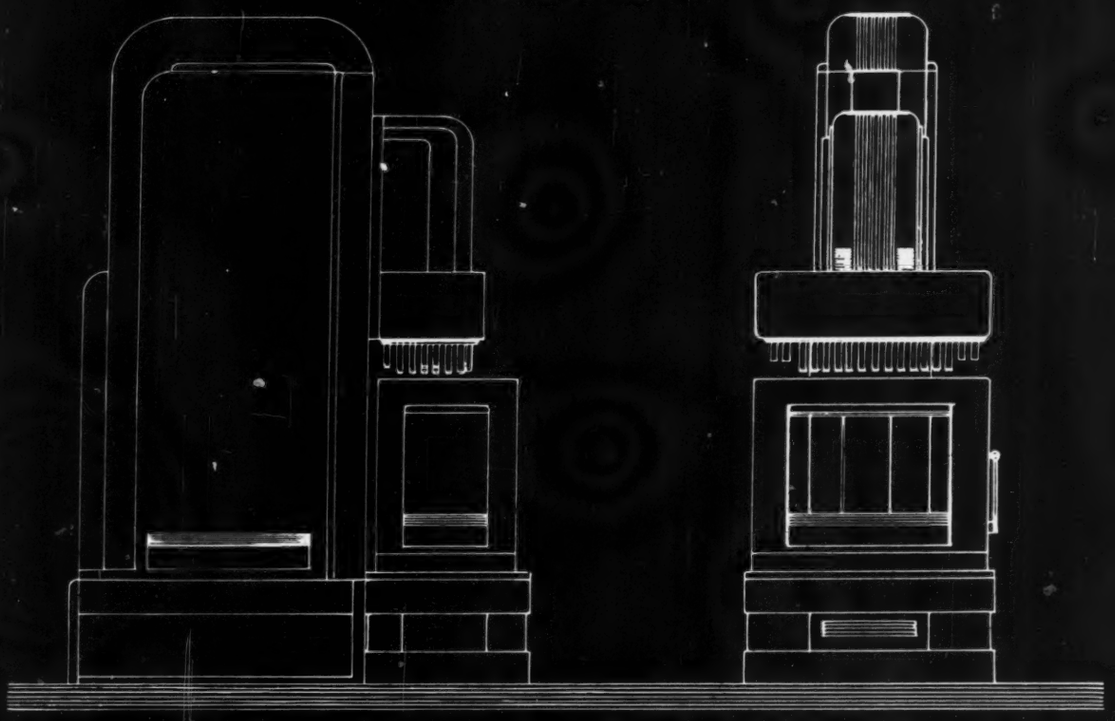


Fig. 1—Proper treatment of machinery from the appearance angle, following the suggested design shown, not only increases use but helps indicate the function of the machine

BUYING and selling cannot be reduced to a mathematical formula. We can make surveys and estimates, determine potential buying power and predict with a certain degree of accuracy the generalities of a market. We can advertise our machines in glowing terms, and back up our statements with scientific facts. Yet in the last analysis the intangibles of presentation, prestige and sales appeal become concrete factors in getting results.

Here is where the appearance of the machine makes a contribution. Obviously only connoisseurs, and these have long since deserted the manufacturing field, would buy an article of utility for its beauty alone. Still, a machine which has been carefully designed, one whose appearance gives emphasis to its function, inspires confidence in its ability to perform. It is certainly better to have a machine radiate assurance rather than misgiving.

Many of our machines have been constructed without a conscious effort toward making eye-appeal an important phase of their design, yet they present a very commendable appearance. However, since this effort is usually made without consistent emphasis and plan, the results are accidental. The prestige which accrues from sustained effort cannot be secured without a program or plan.

There is always more than one way to design and build a machine. There is usually more than one way to build it at the same cost. Designers often do not realize that their hard and fast rules and formulas are, many of them, conventions adopted by the trade. Often the rule of thumb is the best, and serves to prove a point in favor of the appearance factor. A machine built heavier than it need be (and most of them are) gives one a *feeling* of desirable rigidity; a carefully planned *form* would accomplish the same thing, and perhaps with less metal. Designers have a way of justifying their lack of imagination by quoting Louis Sullivan, the father of modern architecture, in the axiomatic "form follows function." But which form? There is a variety available for each problem. This practice has resulted in machines with no, or very little, modern eye-appeal, and any eye-appeal that is built into such machines is quite unintentional. Naturally, with this vague attitude and its afterthought to appearance, it has been necessary to employ the artist-photograph-

er and the retoucher in the presentation. The cleaning-up has been done on the picture, and not on the machine itself.

The style of any manufactured article, and this includes a machine, is usually influenced by the architecture of the period. The ornate lathe of Rococo vintage, *Fig.* 2, illustrates this. It is safe to say that the venerable engine lathe got its curved legs from the lover's seat of the gay nineties. And the automobile, born in the horse and buggy age, could not violate the fashions of that day; in fact it is still waiting for the last wagon to disappear before identifying itself with a modern age and acquiring an appearance consistent with its function.

Today we notice the skyscraper theme in the ingenious devices with which we are encouraged to furnish our homes. Aero-dynamics also has provided an archetype for our age. Just as imitative and unreasonable designers applied the arabesques of Rococo and Mid-Victorian architecture quite indiscriminately to everything within their reach, we find applications of aerodynamic design to stationary articles; we find bathroom scales that look so much like stratosphere liners that we are afraid to tread on them, heating units that look like radios, and radios that look like the portals of heaven. Streamlining is not a cure-all for the ugliness of things. But its simplicity is something worth considering. The proper design not only increases use but, above all, it should help make the article look more like the thing it is, and make it appear more capable of doing what it is supposed to do.

MECHANICAL efficiency is essential — pleasing appearance is highly desirable — conflict between the two cannot be tolerated. Mr. Rosengren, an industrial designer specializing on heavy machinery who is associated with several leading manufacturers, outlines a viewpoint which will do much to relate these twin problems. His article serves well to supplement the contributions by Harold L. Van Doren in the February-April issues.

A Penchant for Complexity?

In the opinion of a prominent mechanical engineer, most designers have a penchant for complexity and a fear of simplicity. They contend that if a complex mechanism will scarcely work, how can a simple one? Paradoxically, there is greater ingenuity in a simple solution than in a complicated one, plus obvious advantages. A most mediocre designer, if given unlimited funds, unlimited parts, unlimited time and space, can, by following the rule books, construct a machine that will work.

Interplay of Ideas Necessary

Likewise it is a simple matter for industrial artists to draw a pleasing shape for a machine, disregarding the fact that a mechanism must be fitted into it. The solution lies in the interplay of ideas between engineer and artist. It does not lie in throwing sheet-iron hoods over offending members, or putting beads on formless castings for no apparent reason. Creative designing is necessary, in practical and harmonious shapes and forms dictated by cost, material, and function.

The following are prime considerations in collaborative design for appearance:

1. What does the machine do?
2. In what direction do major parts move, and at what speed?
3. Is there anything unusual in their moving in these directions and at these speeds?
4. Is the machine portable, and therefore lightness of appearance a factor?
5. Is the machine massive to make it rigid, and is appearance of massiveness desirable?
6. In what surroundings will it be used?
7. Will it be cleaned often enough to war-

Fig. 2—European pole lathe of seventeenth and eighteenth centuries is the earliest known form of lathe. A bow and string, or a cord pulled by an assistant, gave the necessary motion. Appearance was not considered

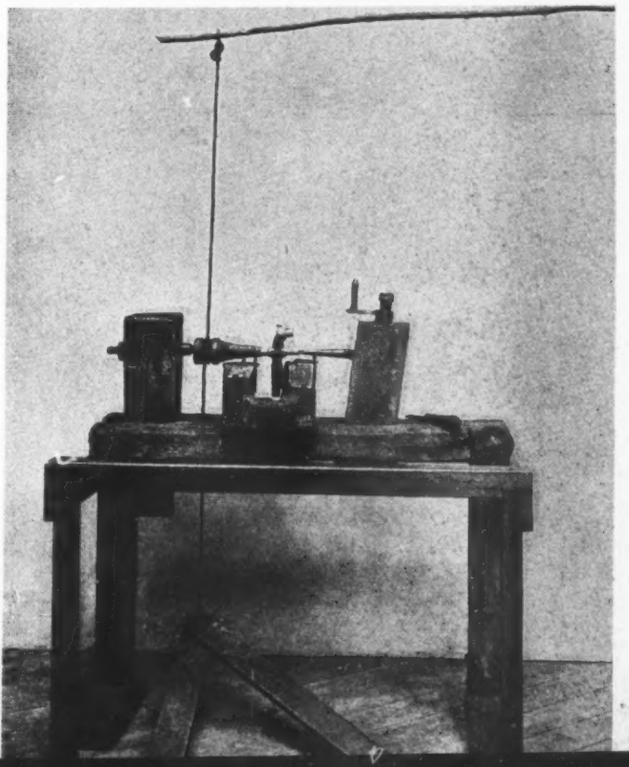
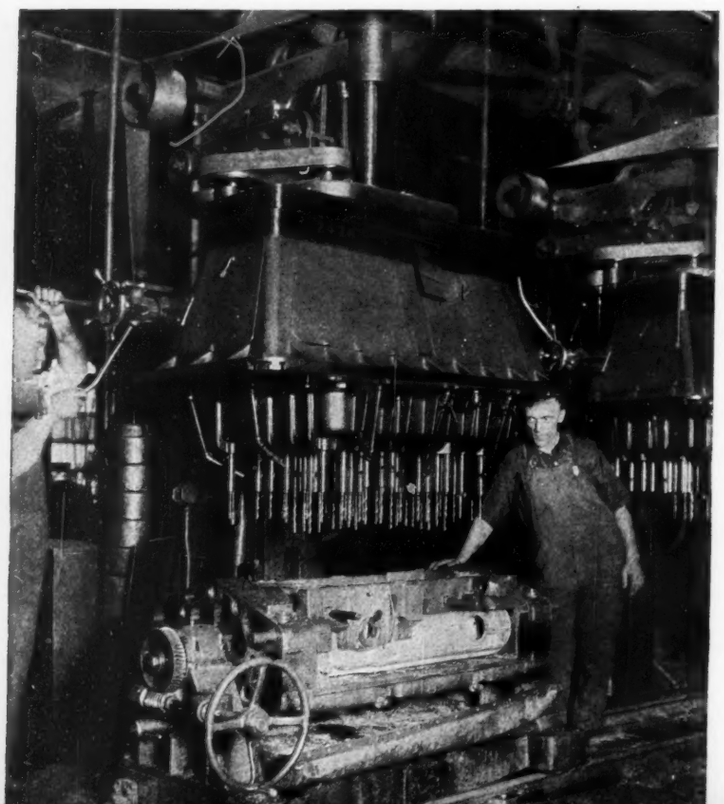


Fig. 3—A mass of rococo decoration by which the frame was concealed was considered as good design for appearance when this German lathe for ornamental turning was built about 1750. At about this time all kinds of articles were decorated in this way

Fig. 4—The introduction of machinery for mass production brought a further step in design, but appearance of the machine was left promiscuously to the forms in which the lines naturally fell



rant care in designing an easily cleaned surface?

8. What parts is it essential to expose in the use of the machine?
9. What parts can be covered without interfering with use?
10. What parts must be covered?
11. In what manner is the machine operated?
12. What provision must be made to handle in-coming and out-going work?
13. Of what basic material is the machine made and why?
14. Why is this material used instead of substitute material?
15. Of what other materials could the machine be made?
16. Where could noncorroding materials replace those used?
17. What is the cost of the material in comparison with substitute material?
18. What is manufacturing cost in comparison with other ways of manufacture?
19. What part or parts will adapt themselves to other positions?
20. Does the designer recognize the possibility of mechanical and structural change?

Embellishments Not Saleable

It must be thoroughly understood that the buyer will not pay for embellishments. He is interested primarily in a machine that can be readily operated, and one which has the quality of construction and materials to stand up under prescribed working conditions. Nothing must interfere with its utility, and the beauty must be calculated to remain a gratuity.

With the engineer seeking to design a superior mechanism, and the industrial artist to amplify this fact, there should result a superior machine. The improved appearance, stressing function, calls attention to the mechanical features of the new design and assists in its presentation.

NOTE—The photographs used as *Figs.* 2 and 3 are reproductions of machines in the South Kensington Museum, London. *Figs.* 2, 3 and 4 are reproduced from *A Popular History of American Invention,* Kaempffert, Charles Scribner's Sons, 1924.

Articles on this and related subjects published in previous issues of MACHINE DESIGN include the following:

"Overcoming Sales Resistance by Color Effects and Finishes," by William J. Miskella, March, 1930, p. 15.

"How Design Affects Sales," by John D. Rauch, Sept., 1930, p. 45.

"Style Consciousness in Design," by J. M. Murphy, Jan., 1932, p. 49.

"Supplementing Mechanical Efficiency with Good Appearance," by Walter Dorwin Teague, Dec., 1932, p. 22.

"Appeal to the Eye," by William B. Stout, Sept., 1933, p. 41.

"Sales Value of Appearance Can Be Protected," by George V. Woodling, Nov., 1934, p. 15.

"Designing for Appearance," by Harold L. Van Doren, Feb., 1935, p. 15; March, 1935, p. 23; and April, 1935, p. 15.

"Enhancing Appearance of Welding," May, 1935, p. 21.

"Sculptural Methods Aid Engineers in External Design," by Harold B. Veith, June, 1935, p. 27.

New Machines Indicate Design Trends

WHEN tools must be movable while the source of power remains at one point, flexible shafts are immediately considered for the design. These parts permit the positive transmission of power while the tool may be moved through a considerable area. A logical step from this type of application is the increasing use of flexible shafts for connecting some integral unit of a machine to a power source when this unit must have moving parts of its own while being moved through a cycle by co-operating parts.

Machines recently announced in addition to those on the next two pages include the following, arranged by fields of application:

Air Conditioning

Household Unit, American Radiator Co., New York.

Factory Equipment, Dail Steel Products Co., Lansing Mich.

Cement

Rotary Clinker Cooler, Traylor Engineering & Mfg, Co., Allentown, Pa.

Chemical

Nonflooding Feeder, Hardinge Co., York, Pa.

Construction

Bantam Weight Rail Crane, Harnischfeger Corp., Milwaukee.

Domestic

Food Mixer, Great Northern Food Products Co., Chicago.

Portable Electric Sewing Machine, Standard Sewing Machine division, Osann Corp., New York.

Food

Rotary Tablet Machine, F. J. Stokes Machine Co., Philadelphia.

Wrapping Machine, Package Machinery Co., Springfield, Mass.

Foundry

Sand Blast Machine, Pangborn Corp., Hagerstown, Md.

Industrial

Electric Hoist, Northern Engineering Works, Detroit.

Diesel Engine, Cooper-Bessemer Corp., Mt. Vernon, O.

Vacuum Cleaning Machine, Kent Co. Inc., Rome, N. Y.

Unit Heaters, Modine Mfg. Co., Racine, Wis.

Elbow Making Machine, Ingels Elbow Machine Corp., Chicago.

Rotary Pumps, Worthington Pump & Machinery Corp., Harrison, N. J.

Dust Collector, American Air Filter Co., Louisville, Ky.

Metalworking

Lapping Machine, Norton Co., Worcester, Mass.

Sheet Bending Machine, Geo. Whiting Co. Inc., Chicago.

Universal Turret Lathe, Warner & Swasey Co., Cleveland.

Flanging Machine, Blue Valley Machine & Mfg. Co., Kansas City, Mo.

L-Type Milling Machine, Cincinnati Milling Machine and Cincinnati Grinders Inc., Cincinnati.

Hydraulic Surface Grinder, Hill Clutch Machine & Foundry Co., Cleveland.

Mining

Crusher and Pulverizer, Braun Corp., Los Angeles.

Pulverizer, Combustion Engineering Co. Inc., New York.

Locomotive, Brookville Locomotive Co., Brookville, Pa.

Office

Electric Desk Calculator, Barrett Adding Machine division, Lanston Monotype Machine Co., Philadelphia.

Printing

Direct Pressure Matrix Press, Ostrander-Seymour Co., Chicago.

High Speed Newspaper Press, Goss Printing Press Co., Chicago.

Paper Cutter, Challenge Machinery Co., Grand Haven, Mich.

Composing Room Saw, American Type Founders Sales Corp., Elizabeth, N. J.

Textile

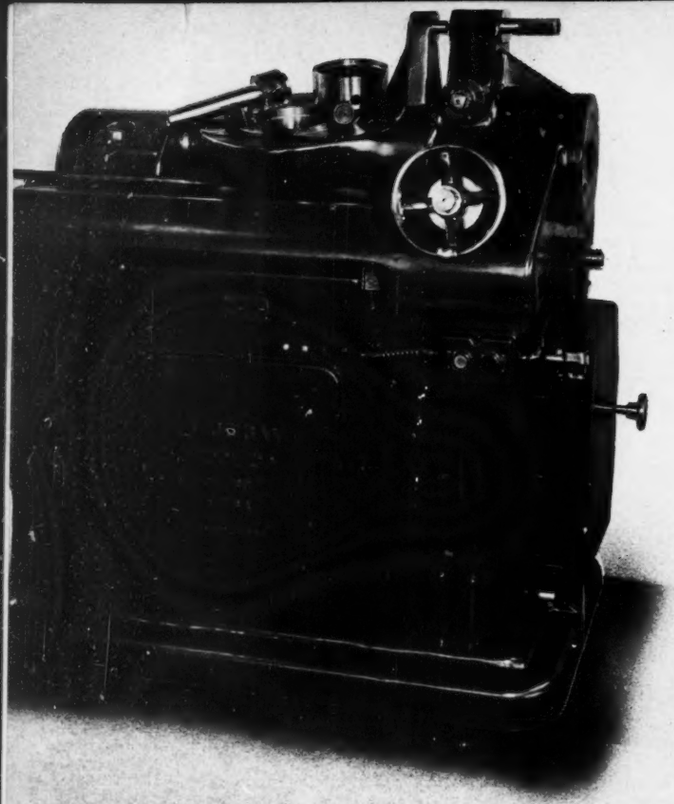
Flat Warp Knitting Machine, Collins Loom Works, Amsterdam, N. Y.

Welding

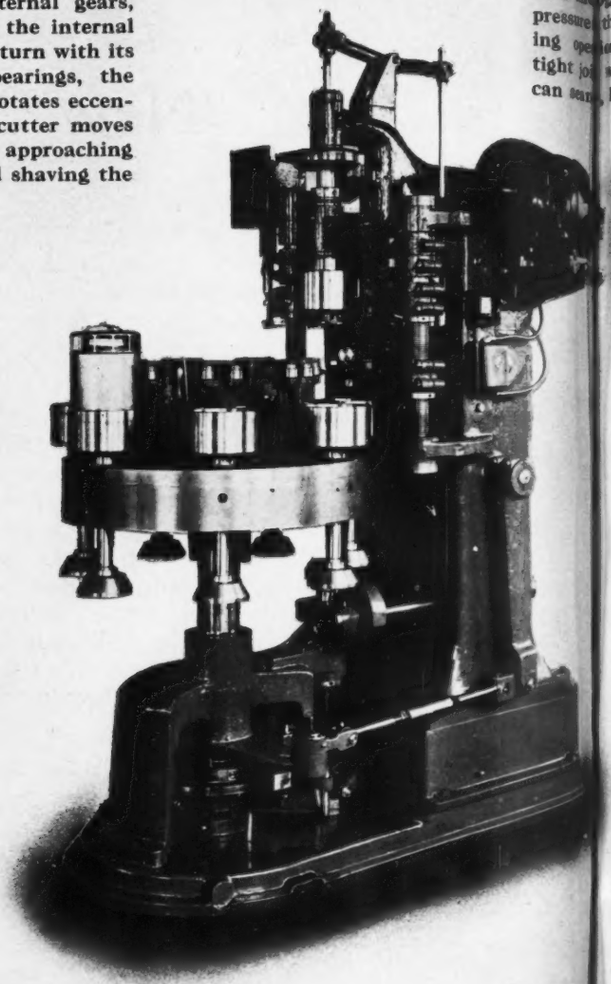
Engine Driven Welder, Lincoln Electric Co., Cleveland.

Woodworking

Sanding Machine, American Floor Surfacing Machine Co., Toledo, O.



AS the cutter-carrying arbor on Michigan Tool finishing machine for internal gears, left, rotates, driving the internal gear which is free to turn with its adaptor on roller bearings, the arbor holder slowly rotates eccentrically so that the cutter moves gradually on an arc, approaching the internal gear and shaving the teeth.



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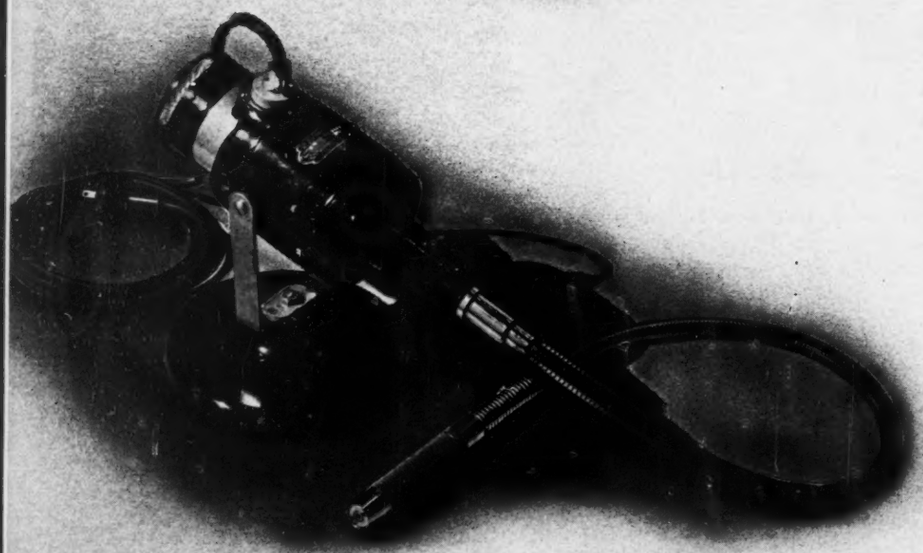
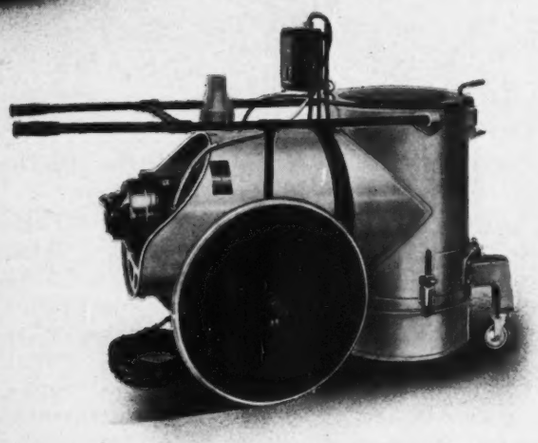
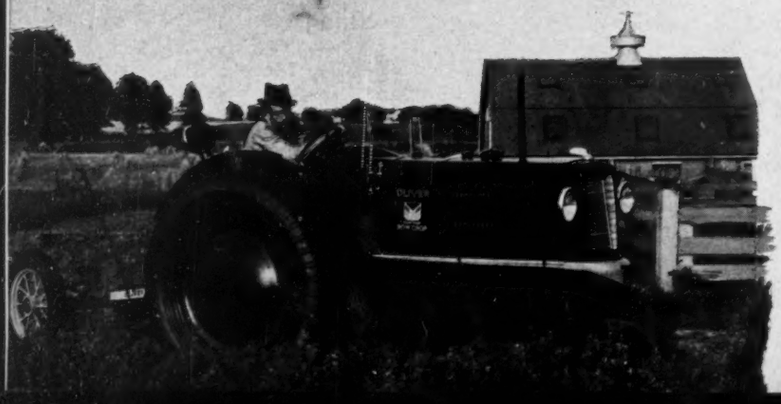


ELECTRIC governor controls the speed on the Dumore flexible shaft tool, left, a twist of the wrist giving instant variations between 1700 and 12,000 RPM. The flexible shaft can be run while bent in a U shape.



FINGER-TIP control of all operations, the almost complete absence of projections, and automotive type steering and gear shifting feature the new Oliver Row-Crop "70" farm tractor, below. Engine RPM can be cut by instant governor adjustment so that the tractor will maintain its rate at lower engine speed but with open throttle.



WITH starting switch, motor and all necessary parts compactly arranged, the Spencer portable industrial vacuum cleaner, above, is moved from place to place on rubber tired wheels. Dust collector consists of an inverted bag which insures clean exhaust air.

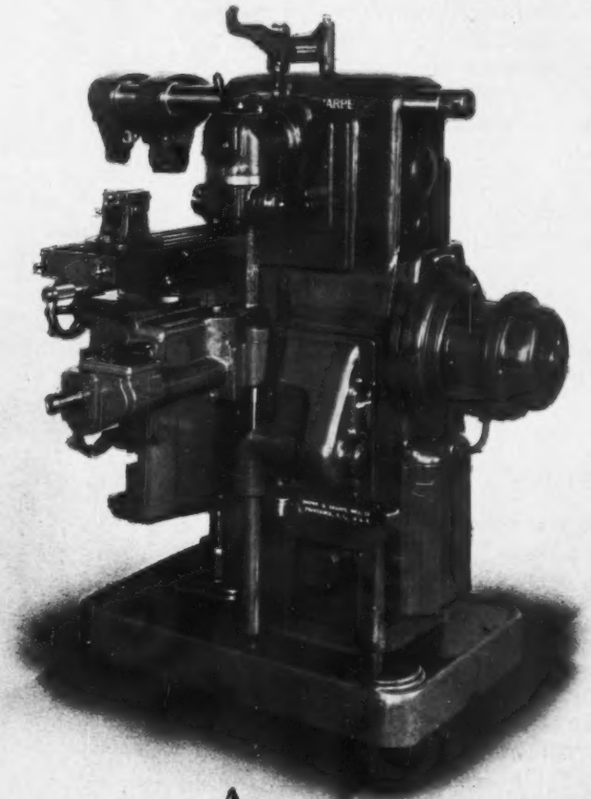
AN ingenious solenoid mo[gle] provide an added pressure [the] finish of the seaming op[en], thus insuring a tight jo[with] Cameron rotary can sea[, below.

CONTROL lever on electric hoist, left, operates motor switch and brake at the same time so that when the switch is turned on the brake is released and vice-versa. An automatic limit stop on this Monnier machine works by means of a sheave coming in contact with a lever which automatically operates the control mechanism.

Design Features in New Machines

A Pictorial Presentation of Recent Machinery from the Standpoint of Design.

TREND toward "building in" is exemplified in Continental Do-All machine, above. A self-contained electric welding device joins the ends of a cut band saw blade after passing one end through starting hole in the work, for inside cutting.



ACCURACY in angular settings of table on Brown & Sharpe Omniversal milling machine, above, in both horizontal and vertical planes, is insured by means of verniers reading to two minutes of arc.

MODERN styling and design for convenience of operation distinguish the Westinghouse dishwasher, below. Oven-type door allows work top surface to be used at all times.

DISTINCTIVE eye-appeal is secured in General Electric cleaner, left, by a maroon bag, maroon pistol grip and trim to match. A redesigned air chamber gives unusual air displacement.

MACHINE DESIGN

Renewed Interest in Research Work Augurs Well for Future

CRITICISM of engineers and engineering on the part of the layman has done little, if any, lasting harm to the engineering profession. At the same time it is gratifying to know that favorable interest in engineering matters again is awakening in the minds of intelligent and influential leaders in banking and industry. Only recently a group of corporation executives and bankers was conducted on a tour of research laboratories, organized by the engineering and industrial research division of National Research Council, to ascertain at first hand the work and influence of these laboratories.

Display of such interest in research may not appear to be of major importance, yet its effects might be far-reaching. While it is questionable whether there has ever been an overabundance of production, the fact remains that stimulation of purchasing is highly desirable and that one means of creating a desire to buy is to put new products on the market. Organized research can do this—especially if properly backed and financed by responsible institutions.

Correct perspective on the part of the men who control the purse-strings, influenced by investigation of the possibilities of research work, would do much to return our manufacturing plants to a healthy condition of individual aggressiveness. If these men could be shown only the "side products" of research and how these in many instances develop into major articles of manufacture, the financial difficulties of many an ambitious company would immediately be solved. No stretch of imagination is needed to visualize the benefits to engineering and industry in general.

Kill That Noise!

WITH all the talk of decibels, sound meters and noise surveys, it won't be long before one will be able to hear himself "think"—maybe even in the forge shop! It is said that New York City's survey and campaign on restriction of noise is to be emulated by many large industrial centers; some have started already, with beneficial results.

Designers of machinery do not have to follow this lead—they're ahead of the game! Noise and vibration-absorbing mountings have been increasingly employed of late, insulation and various other methods have been used for obviating the "soundboard" effect that sometimes arises in welded structures, and closer tolerances or ground teeth have been specified for otherwise noisy gearing.

Noise in machinery is akin to vibration, which in turn is akin to lack of balance or smoothness. By improving the latter, the noise may automatically be dispelled.

Editorial

Professional Viewpoints

MACHINE DESIGN WELCOMES LETTERS SUITABLE FOR PUBLICATION

Mechanism Provides Variable Stroke

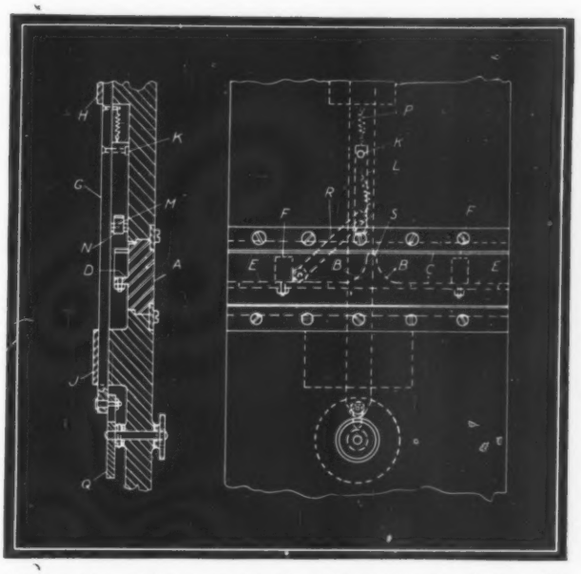
To the Editor:

IN AN AUTOMATIC packaging machine it was necessary to develop a mechanism which would deliver the finished product alternately to a conveyor belt on either side of the machine. As the machine was made to accommodate several sized packages it was necessary to make the stroke adjustable. This was accomplished by the mechanism shown in the accompanying illustration.

Slide *A*, to which was fastened a right-angle shelf arrangement upon which the work dropped after completion, is of the conventional square gibbed slide type. The back of this slide, however, was milled out as shown at *B* to depth *C*. At *D* both sides of lug *E* were slotted to accommodate adjustable stops *F*. These stops could be set to increase or decrease the length of the stroke of slide *A*. At right angles to the slide movement, reciprocating slide *G*, operates in bearings *H* and *J*. This slide has pivoted at *K* a swinging lever *L* to the end of which is fastened by means of pin *M*, a roller *N*. At the upper end of this lever there is attached tension spring *P* which tends to keep the lever in the vertical position when it is not acted upon by curved surface *B*.

Eccentric *Q* is also slotted so that a small amount of adjustment of slide *G* can be obtained if it is desired to vary the stroke.

When setting the slide for operating purposes the slide is set off center to the right an amount equal to slightly more than the diameter of roll *M*, so that lug *S* is in the position shown. Stops *F* are then set so that when eccentric *Q* is at the lowest possible position, roll *M* has engaged stop *F* and pushed it to the left an amount equal to the desired movement required for slide *A*. When this has occurred, lug *S* is on the left side of the center. As slide *G* returns to its highest position, lever *L* through the tension of spring *P* returns to the vertical position. On the next downward stroke *B'* deflects the lever arm to the right until it strikes right-hand stop *F* at which point any further downward movement deflects the slide to the right. The position of lever *L* just before it moves the slide to the left is shown at *R*. Frictional resistance of the slide in the gibs is sufficient to prevent lever *L* from moving the slide on the upward stroke.



Mechanism delivers products alternately to either side of the machine

There is thus accomplished for each revolution of eccentric *Q* an alternate movement to the right and left, and at each movement a completed package is deposited on the conveyor belts.

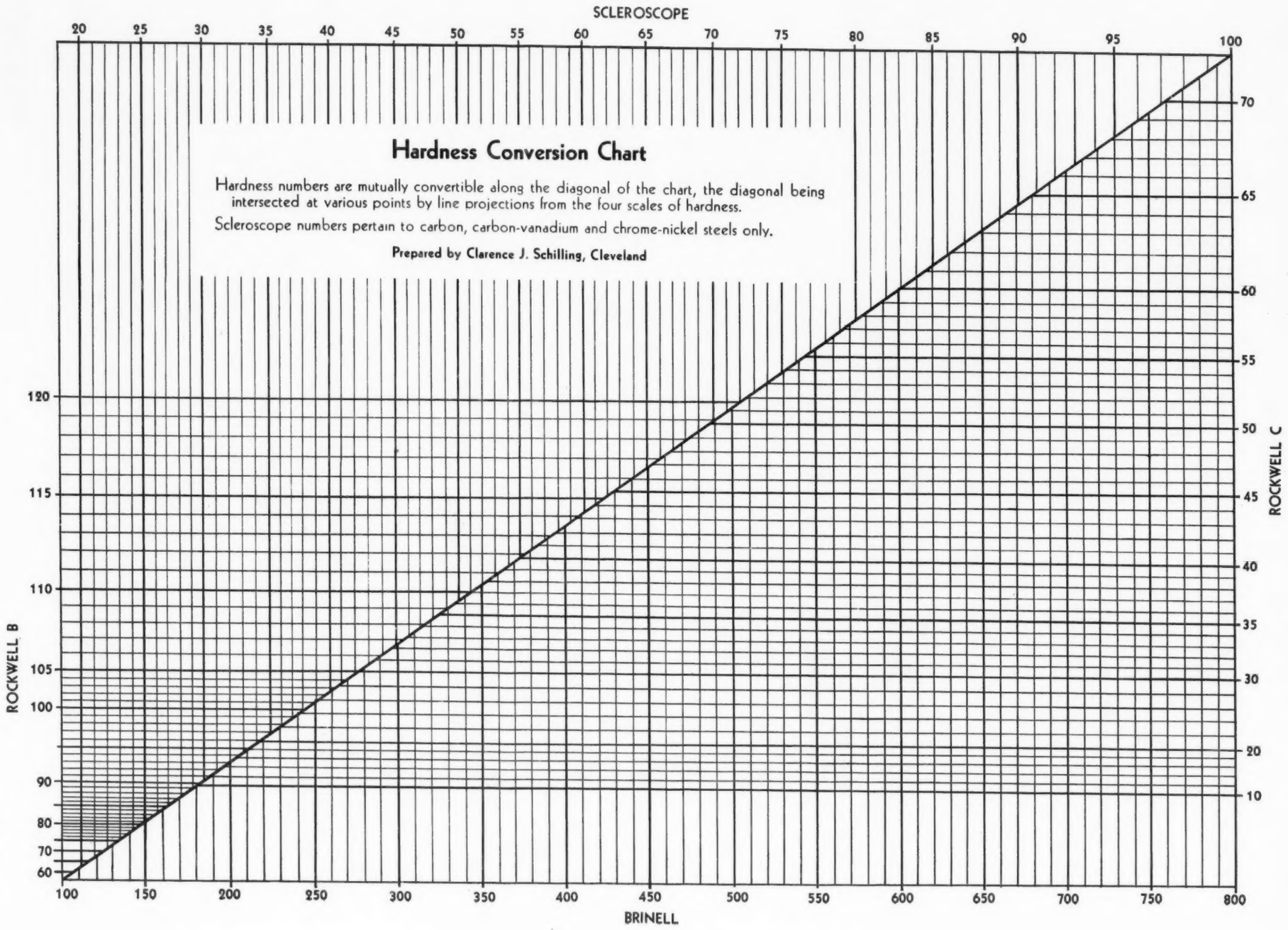
—JOHN A. HONEGGER
New York

Simplifying Hardness Conversion

To the Editor:

THE DIFFICULTY and confusion usually encountered when it is necessary to compare hardness readings secured by two or three of the excellent systems now in use suggested the preparation of the hardness conversion chart shown on page 42 which may be of value to your readers. In this chart hardness numbers are mutually convertible along the diagonal, this diagonal being intersected at various points by line projections from the four scales of hardness—brinell, Rockwell C, scleroscope and Rockwell B. The scleroscope numbers only pertain to carbon, carbon-vanadium and chrome-nickel steels.

—CLARENCE J. SCHILLING,
Cleveland.


SCLEROSCOPE
20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Hardness Conversion Chart
Hardness numbers are mutually convertible along the diagonal of the chart, the diagonal being intersected at various points by line projections from the four scales of hardness.
Scleroscope numbers pertain to carbon, carbon-vanadium and chrome-nickel steels only.
Prepared by Clarence J. Schilling, Cleveland
ROCKWELL B
120 115 110 105 100 90 80 70 60
ROCKWELL C
70 65 60 55 50 45 40 35 30 20 10
BRINELL
100 150 200 250 300 350 400 450 500 550 600 650 700 750 800

MEN of MACHINES

AT ITS recent annual meeting the American Society for Metals elected E. C. Bain vice president. He succeeds R. S. Archer who now heads the organization. A biographical sketch of the latter appeared in the Feb., 1931, issue.

Mr. Bain is assistant to the vice president in charge of metallurgy and research, United States Steel Corp., he having joined this company in 1928. Born Sept. 14, 1891, in LaRue, O., he studied at Ohio State university, graduating in 1912.

Past affiliations include the bureau of standards, faculties of Ohio State and Wisconsin, B. F. Goodrich Co., General Electric, Atlas Steel Car Corp., and Union Carbide & Carbon research laboratories. During the war Mr. Bain did work on gas masks, for which he was commissioned first lieutenant.

E. C. BAIN

• • •

TO HEAD the Foster Wheeler Corp. its board of directors recently chose Harry S. Brown. He is a Cornell graduate and received his degree in engineering.

After leaving the university he joined the engineering department of the Power Specialty Co. In 1919 he resigned to accept the position of vice president of Wheeler Condenser & Engineering Co. When the two companies were consolidated he retained his post and in addition became a director.

Mr. Brown's personal experience with engineering and designing has been centered in the manufacture of condensers, pumps, steam jets and allied units. He also has been associated with the development of much special equipment for chemical and other industrial enterprises.

HARRY S. BROWN

• • •

NEW president of the American Society for Testing Materials is H. S. Vassar, laboratory engineer, Public Service Electric & Gas Co., Irvington, N. J. After graduating from Pratt Institute in 1903 he became employed in the engineering and operating departments of this company and has since continued in its service. Now he has charge of the large testing laboratory.

Prominent in the various phases of the American Society for Testing Materials, Mr. Vassar has been a member of committee D-9 on electrical insulating materials since 1918 and has served on committee D-11 on rubber products since 1917. From 1932 to 1934 he was a member of the executive committee and served as vice president prior to his recent election to the presidency. Mr. Vassar took an active part in the organization of

H. S. VASSAR

the sectional committee on electric insulating materials which is sponsored by the A.S.T.M. under the procedure of the American Standards association, and he is one of the representatives of the electric light and power group on this committee organized last year.

♦ ♦ ♦

JAMES L. WICK Jr., president and general manager of Falcon Bronze Co., Youngstown, O., has been elected vice president of the American Foundrymen's association to fill the vacancy occasioned by the death of Vice President B. H. Johnson. He has been active in the organization for many years, serving on committees and as a director.

RUSSEL JOHNSON, formerly chief draftsman for the Comet Motor Co., Madison, Wis., and since 1932 a member of the mechanical engineering department faculty of Michigan College of Mining and Technology, has been promoted from instructor to assistant professor.

♦ ♦ ♦

ZAY JEFFRIES, consulting metallurgist, Cleveland, received the Albert Sauveur award of the American Society for Metals in recognition of his outstanding achievements in metallurgy.

♦ ♦ ♦

DR. JAMES F. BURKE has been elected president of the International Electrochemical Commission. He is widely known as an inventor.

♦ ♦ ♦

RALPH R. TEETOR, vice president in charge of engineering, Perfect Circle Co., recently was nominated as president of the Society of Automotive Engineers.

♦ ♦ ♦

GLEN D. ANGLE, Detroit consulting engineer, will teach machine design, thermodynamics and automobile and aircraft engine design at Lawrence Institute of Technology during this year.

♦ ♦ ♦

CHARLES F. SCOTT, professor emeritus of electrical engineering, Yale university, was elected chairman of the Engineer's Council for Professional Development at the third annual meeting held Oct. 8 in New York.

♦ ♦ ♦

TRYGVE D. YENSEN, engineer of the magnetic division of the Westinghouse research department, was one of the recipients of the Henry Marion Howe medal awarded by the American Society for Metals recently. The other recipient was N. A. ZEIGLER, former associate of Dr. Yensen.

♦ ♦ ♦

WILLIAM F. DURAND recently was awarded the 1936 John Fritz gold medal for notable achievement "as an authority in hydrodynamic and aerodynamic science, and in its practical application." A biographical sketch and picture of this outstanding leader in research and engineering education appeared on page 47 of October MACHINE DESIGN.

♦ ♦ ♦

G. R. CARROLL recently was elected president of the Association of Iron & Steel Electrical Engineers. He is electrical superintendent of the Aliquippa works of Jones & Laughlin Steel Corp.

♦ ♦ ♦

OSCAR H. BUSCHMANN has been appointed assistant chief engineer of the Brunner Mfg. Co., Utica, N. Y. Previously he had been refrigeration and designing engineer with Chrysler Corp. and assistant chief engineer for Universal Cooler Corp.

♦ ♦ ♦

ED. W. FERRY is president of the newly organized E. W. Ferry Screw Products Co., Cleveland. Formerly with Ferry Cap & Screw Co., he received his early technical training at Case School of Applied Science, graduating in 1918 with a degree in mechanical engineering.

♦ ♦ ♦

DR. E. D. SAKLATWALLA, vice president and director, Vanadium Corp. of America, has resigned to devote his efforts to the formation of a new organization for research and development in new steels and alloys.

♦ ♦ ♦

CLEMENT CLARENCE WILLIAMS, dean of the college of engineering, University of Iowa, has been elected president of Lehigh university to succeed Dr. Charles Russ Richards, recently resigned.

♦ ♦ ♦

A. B. BOK, formerly special service and development engineer for Cincinnati Milling Machine Co., has joined the Kent-Owens Machine Co. For the past eight years he has been in responsible charge of many important machine design developments, a number of which involved hydraulic control.

Obituaries

ERNEST S. HIRSCHBERG, chief engineer of Dings Magnetic Separator Co., Milwaukee, died suddenly recently. He was fifty-two years old.

♦ ♦ ♦

OSCAR JUNGGREN, pioneer G. E. designer of high speed steam turbines, died at the age of 70 recently. He was associated with W. L. R. Emmet in the development of the first large Curtis turbine in 1903. Between 1924 and 1932 he produced 30 original turbine designs, including the steeple compound for which he was awarded the Charles A. Coffin medal in 1931.

♦ ♦ ♦

EUGENE BOURNONVILLE, 73, mechanical engineer, inventor and pioneer in the development of acetylene gas illumination, died recently in Jersey City, N. J. He developed the oxyacetylene gas torch and the welding process used with it. Recently he was reported to have developed a rotary valve for automobile engines, after twenty-five years of experiments.

ASSETS *to a* BOOKCASE

Elements of Machine Design

By Dexter S. Kimball and John H. Barr; published by John Wiley & Sons Inc., New York; available through MACHINE DESIGN *for* $4.00 *plus* 15 *cents postage.*

While bringing up-to-date each topic of this volume with a third edition, the authors have introduced no radical changes. As in previous revisions, catalog material and data that are subject to rapid change have been excluded. New text matter has been added where necessary but without increasing the size of the book. Inasmuch as the title indicates its contents, and because the book already is known to many, no comment is necessary other than to say it belongs in every designer's library

□ □ □

Graphic Course of Patentable Inventions

By H. A. Toulmin; published by D. Van Nostrand Co. Inc., New York; available through MACHINE DESIGN *for* $1.00 *plus* 15 *cents postage.*

In the forty pages of this book the author presents a simple and graphic exposition of each one of the major steps in the life of an invention in its three principles phases. These are: Development of an invention from an idea into a tested and completed apparatus or process; protection of the invention by a patent; enforcement of the patent in the courts. Purpose of this volume is to provide the engineer with background for a better understanding of patent law.

□ □ □

Procedure Handbook of Arc Welding Design and Practice

Published by Lincoln Electric Co., Cleveland; available through MACHINE DESIGN *for* $1.50 *plus* 15 *cents postage.*

Since this handbook was introduced in 1933 two additional editions have been published, this being the third. The present volume is some 140 pages larger than the preceding one. New features added include A. W. S. specifications for filler metal; A.S.M.E. boiler code requirements for butt welds in heavy plate; hard facing of ferrous metals; procedures, speeds and costs for making all types of welds in sheet metals; examples of redesigning for arc welding, etc. The contents are divided into eight principal sections which cover practically every use and application of arc welding.

□ □ □

Diesels and Other Engines

By Howard E. Degler; published by American Technical Society; available through MACHINE DESIGN *for* $2.50 *plus* 15 *cents postage.*

Perhaps few other developments have received the attention in recently published volumes that has been accorded the diesel engine. To this imposing list is added another which constitutes an enlarged and thoroughly revised edition of "Internal Combustion Engines," written by the same author in 1931. The new sections include considerable material on high speed diesel engines, economics of diesel power, improved fuel injection methods, etc.

□ □ □

Cast Metals Handbook

1935 *edition; published by American Foundrymen's association; available through* MACHINE DESIGN *for* $4.00 *plus* 15 *cents postage.*

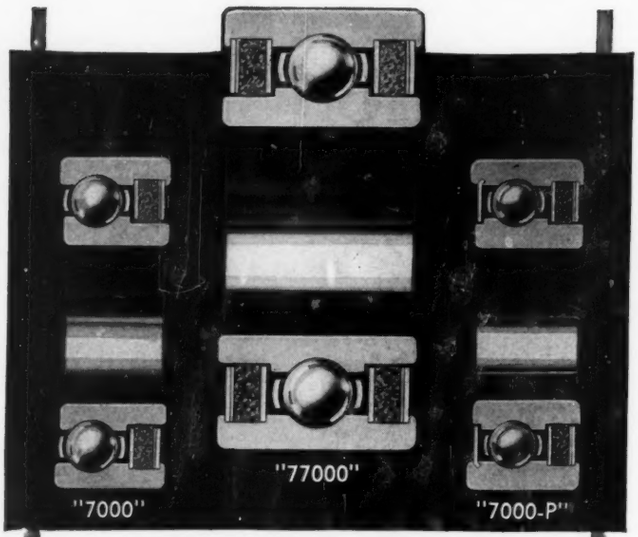
Noteworthy is the fact that this handbook is the first ever published devoted exclusively to the properties and applications of cast materials. It brings information on castings up-to-date, and corrects much erroneous and obsolete data on which engineers have based their calculations. The eight sections into which it is divided include recommendations to designers of castings. Four parts deal with the properties and applications of cast iron, malleable iron, steel and nonferrous metals and alloys.

□ □ □

Sociology of Invention

By S. C. Gilfillan; published by Follet Publishing Co., Chicago; available through MACHINE DESIGN *for* $2.00 *plus* 15 *cents postage.*

Written for all students of invention in its broader, social aspects, this book gives attention to history and civilization as affected by invention. The author, a social scientist, offers some stimulating thoughts.



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Noteworthy Patents

UTILIZATION of the one-way clutch idea has made possible a tensioning device for chains, belts, etc., as revealed in a patent granted recently in this country and assigned to Renold & Coventry Chain Co. Ltd., Didsbury, Manchester, England. Referring to *Fig.* 1, a jockey wheel or sprocket sleeve *A* rotates upon a cylindrical bearing block *B* which itself is pivotally mounted about a bearing pin *C* attached to a backplate.

Coil spring *D* housed in a recess in a spigot *F*, mounted rigidly on the backplate, presses against a plunger which in turn is pressed against the side of an aperture in the bearing block. The bearing block thus is urged to swing clockwise, the device being so mounted, of

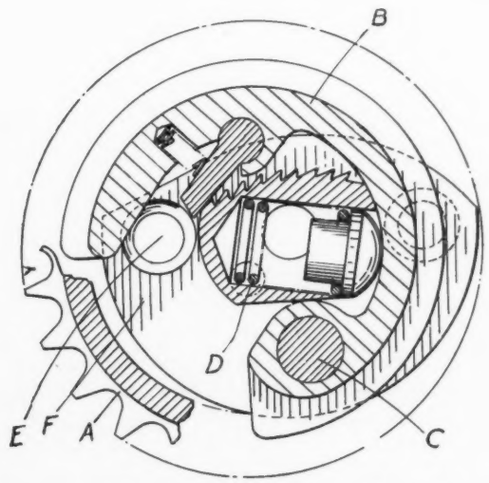
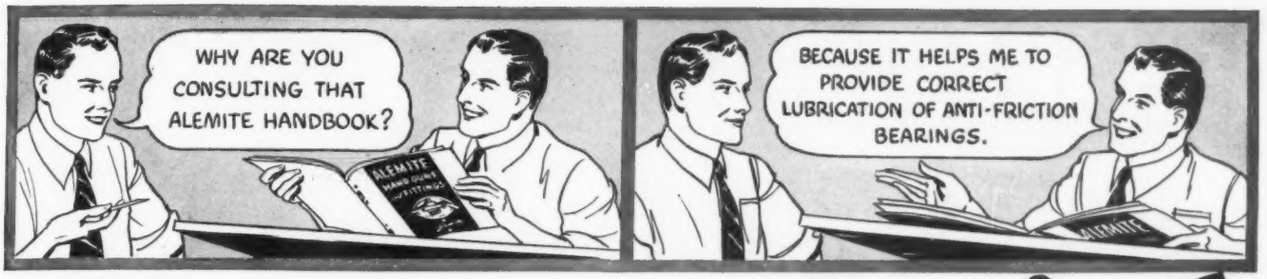


Fig. 1—*As slack occurs in a chain this tension device takes it up automatically*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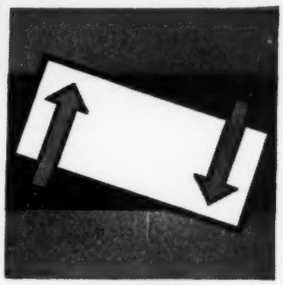
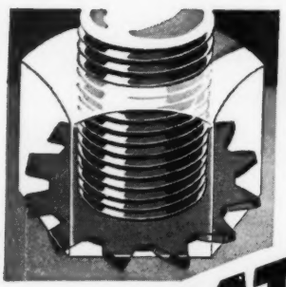
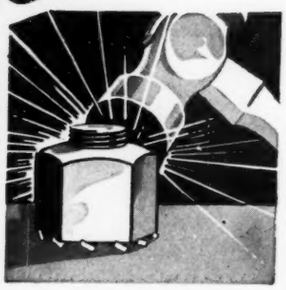
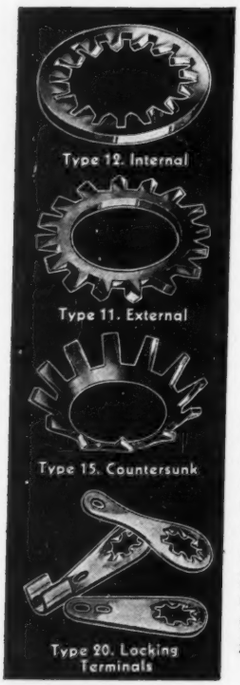




MORE LOCKING POINTS!

SENSATIONAL HOLDING POWER!





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U. S. Pat. 1,419,564—1,604,122—1,697,954 1,782,387 Other Pat. Pending—Foreign Pat.

Lock Washer Company

Distributors of Shakeproof Products Manufactured by Illinois Tool Works

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course, that movement in this direction tightens the chain. Anti-clockwise movement is not possible due to the action of the pawl and ratchet. The parts are shown in *Fig.* 1 in the position they occupy when the chain is at its initial tension. Counterhole *E* in the backplate receives the bolt used in securing the tensioner to a fixed support. Number of the patent is 2,014,-984.

COMBINATION of a number of valves with an air-operated clutch through which the machine is driven, provides the means for a safety arrangement in a recently patented bottle handling machine and control. In the top plan view, *Fig.* 2, is shown a mechanism that guards against maloperation should a bottle for any

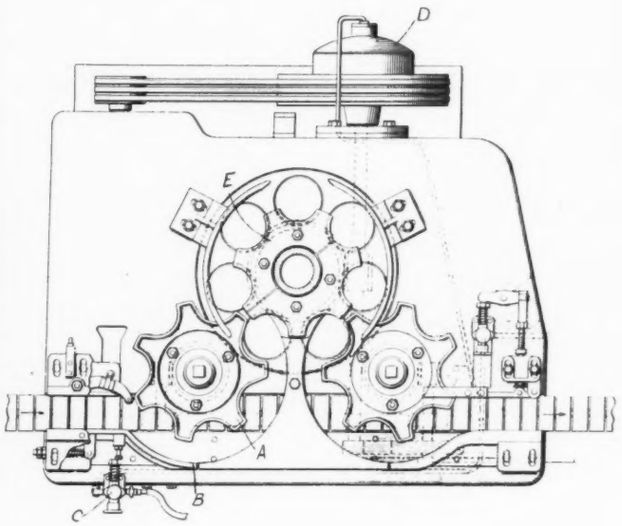

Fig. 2—Actuation of an air valve when a bottle upsets stops the operation of the machine

cause become tipped over. When this happens the infeed spider *A* will force the bottle into contact with guard *B* that in turn actuates a valve on assembly *C*, cutting off the supply of air employed in actuating clutch *D* and thereby stopping the machine.

From the infeed spider the bottles are transferred to a capping head spider *E*, by which they are carried around, capped and conveyed to a discharge spider. By this recessed wheel the capped bottles are taken to a conveyor that carries them forward for subsequent operations. Crown Cork & Seal Co. is assignee of the patent, designated No. 2,013,144.

TO OBTAIN uniformly cut kernels of green corn it has been found necessary to employ a sensitive gripping device that will center the ears of corn regardless of their shape as they

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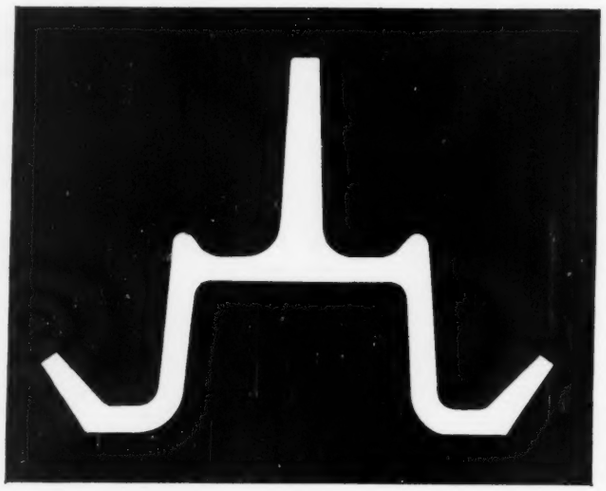

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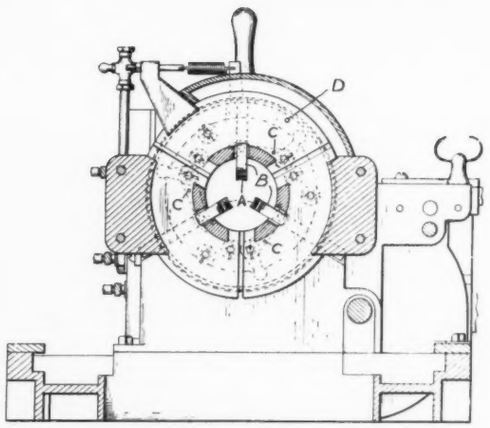

Fig. 3—Sensitive gripping device centers ears of corn, regardless of their shape, in the mechanism that cuts the kernels off the cob

enter the cutting mechanism. A patent, covering this type of arrangement, has been assigned to Food Machinery Corp. When the ear of corn expands members *A, Fig.* 3, upon entering the machine, slides *B* are moved radially. These slides are pivotally connected to rocker arms *C* which are in turn attached to an equalizing ring *D,* mounted for rotary movement in the head of the machine.

When the centering and guide members *A* are expanded by a passing ear of corn, the three slides *B* will be moved in their ways and because of the pivotal mounting of rocker arms *C* in ring *D,* the entire assembly will move as a unit. In other words, all slides *B* will move uniformly and the center of the ear will be held in line with the center of rotation of the cutter head.

A spring maintains tension on the centering assembly so that it will return immediately to its smallest opening when the ear of corn has passed out of contact with the centering members. This patent is designated 2,015,299.

Other Recent Patents in Brief

FRICTION TESTER—2,018,689—Sixteen claims. Stewart Manor. Assigned to Raybestos-Manhattan Inc., Passaic, N. J.

MILKING MACHINE PULSATOR—2,018,713—One claim. S. J. Erling. Assigned to DeLaval Separator Co., New York.

ROTARY CUTTER—2,018,774—Twenty-five claims. E. A. Bessom. Assigned to United Shoe Machinery Corp., Paterson, N. J.

COIL TURN COUNTER—2,019,286—One claim. Herman Arber. Assigned to General Cable Corp., New York.

AIR CONDITIONING APPARATUS—2,019,351—One claim. H. F. Lathrop. Assigned to General Electric Co.

STOCK CUTTING MECHANISM—2,019,465—Eight claims. Norbert Rubin. Assigned to McKinney Tool & Mfg. Co., Cleveland.

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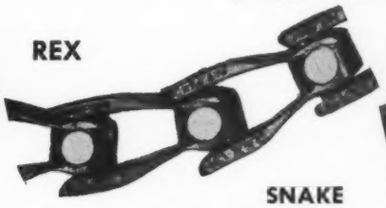
Also available in the complete Rex Line are many special chains, built for particular industries: such as lumber, oil, construction machinery, sugar mills, steel mills, mines and quarries.

CHAIN BELT COMPANY

1643 W. Bruce Street **Milwaukee, Wisconsin**

Cable Address: BELTCHAIN

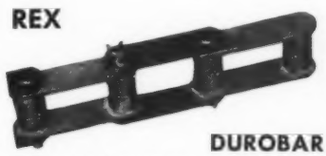
REX



SNAKE

A conveyor chain that flexes in any direction on a short arc. Especially useful in remodeling, as it is adaptable to changed layouts.

REX



DUROBAR

The added metal on the barrel of the block links makes this a longer lasting combination chain—especially when cast in Z-Metal. (See back cover.)

REX

LEY BUSHED

Designed for exceptionally severe service conditions handling gritty and abrasive materials.

REX

CHABELCO

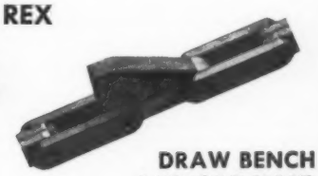
A highly developed steel chain with Rex Press Fit and Unit Link construction. For heavy duty drives and conveyors.

REX

ROLLER CHAIN

The most highly finished chain on the market today for long service and low cost on high speed drives.

REX



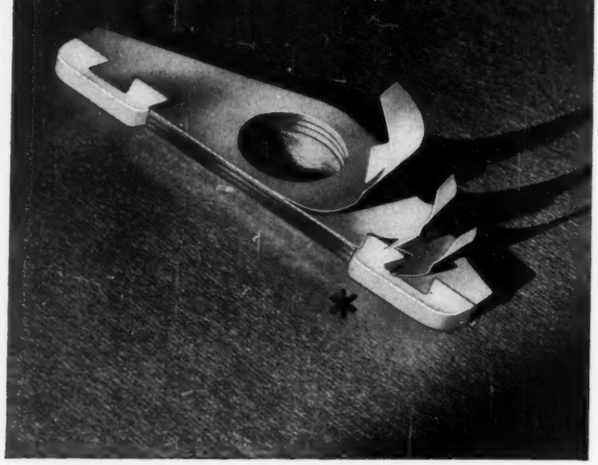
DRAW BENCH AND CAR HAUL

For metal drawing, steel transfer, and car haul service. These chains have extremely high tensile strengths—permit tremendous loads.

CHAIN BELT COMPANY

REX CHAIN FOR EVERY DRIVE AND CONVEYOR

Correcting and holding bearing oil pressure



*OIL SEAL . . . PLUS PRECISION SERVICE ADJUSTMENTS! The soft babbitt tips stop bearing leakage and oil pressure loss . . . the laminated body of the shim provides the means for precision service adjustments of .002" or more. No filing . . . no miking. ● You simply p-e-e-l off one lamination or more for each adjustment! ● Adopted by leading bearing designers to correct oil pressure conditions and because they provide both (1) the practical economy of service adjustments and (2) the precision required by modern bearings. *Available with either .002 or .003" laminations. Sample on request.*

The solid shim that p-e-e-l-s for adjustment

LAMINUM

LAMINATED SHIM CO. 2126-44th Av., Long Island City, N. Y.
Cleveland Detroit Milwaukee

552

Calendar of MEETINGS and EXPOSITIONS

DATA on theoretical and research developments of great importance to the designer will be brought up to date December 2-6 * * * Useful information presented at the New York mechanical engineers meeting will result in changes in design during the next year * * * Creep of metals, an important factor in the study of materials, comes in for especial attention. . . . R. W. Bailey, A. Nadai, E. A. Davis, R. G. Sturm, C. Dumont, F. M. Howell and C. G. Anderson will discuss this topic, the design aspects of creep, and methods of analyzing creep * * * Plastic materials, daily more widely employed in design, also will be discussed. . . . M. M. Frocht is to present information on the mechanical properties of Bakelite and its behavior at failure. . . . Marbiette as a new photoelastic material will be the subject of A. G. Solakian * * * An important problem in today's economic situation, the human problems as created by the introduction of labor-saving machinery, is the topic of Prof. Elizabeth F. Baker * * * Many additional aspects of engineering and design will be considered in the engineering sessions sponsored by the various divisions of the society.

Nov. 12-15—

International Acetylene association. Thirty-sixth annual meeting to be held at Cleveland hotel, Cleveland. H. F. Reinhard, 30 East Forty-second street, New York, is secretary.

Dec. 2-7—

Exposition of Chemical Industries. Fifteenth exhibition to include new machines will be held at Grand Central Palace, New York. Charles F. Roth, Grand Central Palace, New York, is manager.

Jan. 13-16—

Coin Machine Show. Annual exhibition sponsored by National Association of Coin-Operated Machine Manufacturers to be held at Hotel Sherman, Chicago. C. S. Darling, 120 South LaSalle street, Chicago, is secretary.

Jan. 20-24—

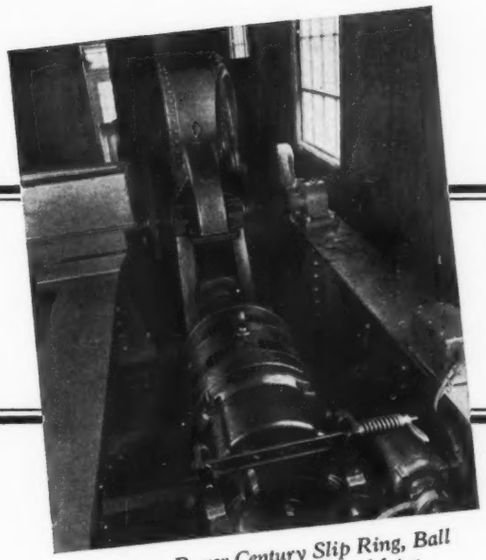
American Road Builders association. Annual meeting and exhibition of equipment to be held at Municipal Auditorium and Exhibition Hall, Cleveland. Charles M. Upham, National Press building, Washington, is managing director.

Jan. 27-31—

International Heating and Ventilating Exposition. Fourth exhibition to be held at International Amphitheatre, Chicago. Information may be obtained by addressing the Exposition at Grand Central Palace, New York.

Jan. 28-31—

American Institute of Electrical Engineers. Winter meeting to be held in New York. H. H. Henline, 33 West Thirty-ninth street, New York, is secretary.



35 Horse Power Century Slip Ring, Ball Bearing, Open Type Crane Motor

One of Century's Many Big Jobs

Up to October first—334 Century Motors were specified for Lock and Dam Operating Machinery, Hoists and miscellaneous equipment comprising the Upper Mississippi 9-ft. Channel Development . . . Size ranges: 7½ to 75 Horse Power.

BIG MOTORS for Your Tough Jobs

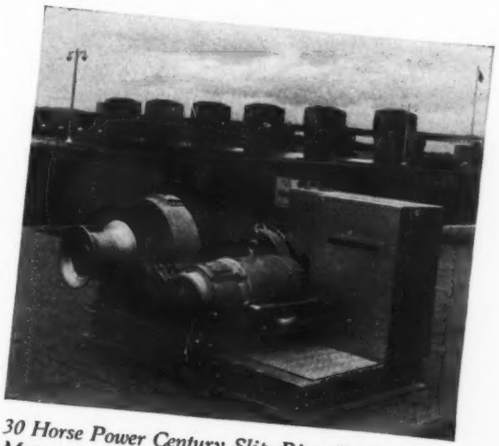
For all tough jobs—where the load is hard to start . . . Where the motor must be self-protected against splashing water . . . Where speed-change requirements must be met . . . Where dust or explosive atmospheres surround the installation—there's a Century Motor of the right size, type and mounting to do the job with unfailing satisfaction.

25/5 Horse Power Century 2-Speed, Splash Proof, Squirrel Cage Motor for Operating Miter Gates in the Locks

What Century Motors Do for Others They Will Also Do for You

The photographs at the left illustrate only one of the many Century Motor jobs where the ability to "Keep a-Running" is the final, acid test. Most of the motors in this big job are constantly exposed to the elements.

Remember: What Century Motors Do for Others, They Will Also Do for You!

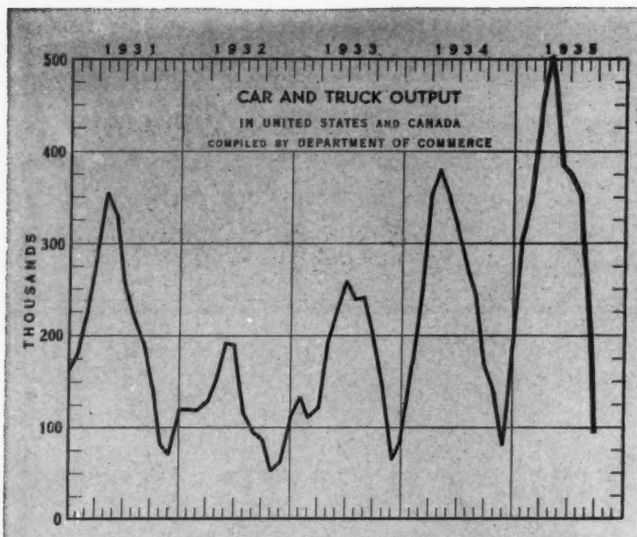


30 Horse Power Century Slip Ring Splash Proof Motor Operating Tow Haulage Engine Used to Draw Barges Through Locks

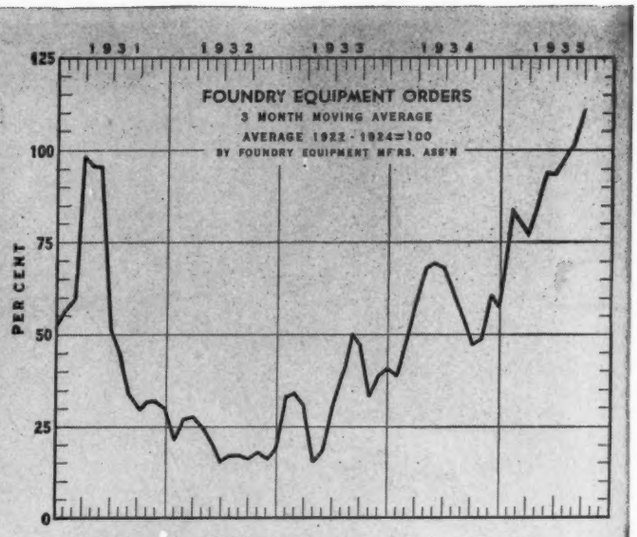
CENTURY ELECTRIC COMPANY
1806 Pine Street St. Louis, Mo.
Offices and Stock Points in Principal Cities

Century MOTORS
UP TO 600 HORSE POWER

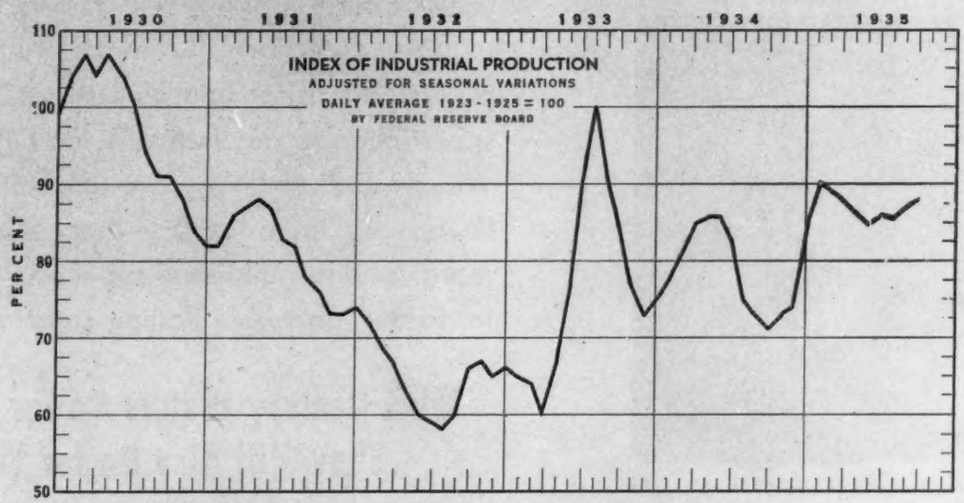
How is Business?



September 1935, 95,128—*September* 1934, 175,586



September 1935, 111.8—*September* 1934, 46.7



September 1935, 88—*September* 1934, 71

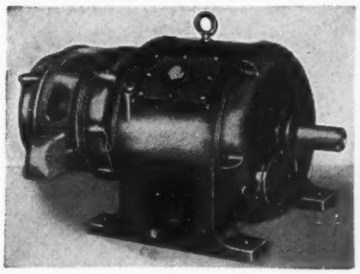
September 1935, 108.5—*September* 1934, 37.4

September 1935, 81.9—*September* 1934, 74.0

NEW *Materials and Parts*

Markets New Gearmotors

GEARMOTORS in a complete line including helical gear and worm gear units, either direct connected or coupled types, in single, double and triple reductions for horizontal, vertical and right-angle drive are now being marketed by Diehl Mfg. Co., Elizabethport, N. J. The motors on the double and triple reduction units



Motors in reducer units are supported from the gearcase which is ruggedly constructed

are supported on the gearcase which is ruggedly constructed to handle the heavy torque loads of the slow speed shaft, and the combination is designed for heavy duty service.

These helical gearmotors are particularly adapted to drives which require ¾ to 75 horsepower and speeds down to 6 RPM on the slow speed shaft when used with a 1750 RPM motor. Lower speeds are available by using slower speed motors. Worm gearmotors are obtainable in power capacities from ¾ to 40 horsepower with speeds on the slow speed shaft down to 30 RPM. Worms are made of high carbon alloy steel integral with shaft, carbonized, hardened, ground and polished.

Disk Rings Transmit Torque

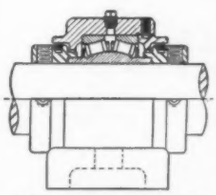
FLEXIBLE laminated disk rings are employed to transmit the torque and accommodate angular and parallel misalignment in the new type "DBZ" coupling of Thomas Flexible Coupling Co., Warren, Pa. The complete ring is built up in packs, the grain of the metal of each disk being laid alternately two ways, the strong way of the steel, in order to get a complete flexible ring of uniform strength at any point of the circle. From this known strength the horsepower and misalignment capacities of the coupling are computed. As there are no bearing points in the couplings, they operate without friction, noise or wear, or need of lubrication. There is no backlash, point or line

Loads OF BEARING CAPACITY
..IN A COMPACT HOUSING

★ Shafer Double-row Bearings provide generous radial-thrust load capacity in a simple, compact, and sturdy pillow block unit.

The exclusive Shafer CONCAVE roller design combines—1. Roller bearing capacity for any combination of radial-thrust loads, 2. Integral self-alignment, 3. Simple adjustability. Only Shafer bearings offer this combination of features that means free rolling anti-friction performance under all conditions, simplest installation, long service life at high efficiency with least attention.

Pillow Blocks available in a full range of sizes; also Flange Units, Hanger Boxes, Cartridge Units, Take-up Units, Conveyor Rolls, Duplex Units, Radial-thrust Roller Bearings. Write for Catalog 12.

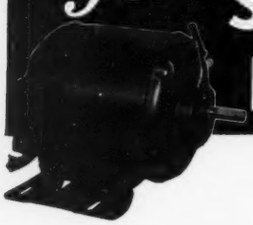


Note piston ring seals and double square □ drive collars

SHAFER BEARING CORPORATION
6513 West Grand Avenue - Chicago, Illinois

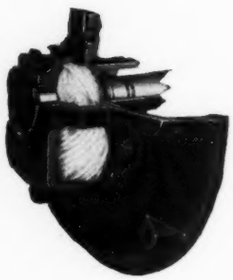
SHAFER
roller bearing
PILLOW BLOCKS

Wagner Motors *for* Satisfactory Performance



FOR refrigerators, washing machines, stokers, oil burners, fans, air-conditioning systems and other household and commercial motor-driven equipment, motor DEPENDABILITY is vitally necessary. Wagner, with 44 years experience in building and servicing motors, has developed a complete line of dependable motors for such appliances.

A few distinctive features contributing to the dependability of Wagner motors are:



√ **Steel-backed babbitt-lined bearings** — steel-backed to withstand all strains — babbitt-lined to prevent "bearing seizure".

√ **Wool-yarn lubrication** — carries an uninterrupted supply of filtered oil to all parts of the bearing.

√ **Rolled-steel frame** — strong, rigid, will not get out of alignment — unbreakable.

√ **Insulated stator coils** — securely wedged in place by special tough fibrous slot insulation.

√ **Special treated stator core** — carefully baked in drying ovens to drive out all moisture — windings thoroly impregnated with heavy insulating varnish.

There's a dependable Wagner motor ideally suited to meet your requirements. Write for Bulletin 167 which completely describes Wagner motors.

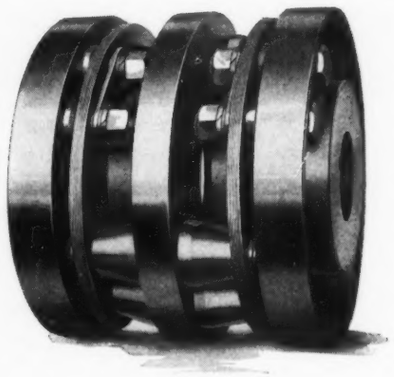
S635-3F

Wagner Electric Corporation
6400 Plymouth Avenue, Saint Louis, U.S.A.

MOTORS - TRANSFORMERS - FANS - BRAKES

contacts, the torque being transmitted across the grain of the ring.

The type "DBZ" couplings are especially designed for heavy duty, high and low speed motor and engine drives. They can be applied to blowers, motor generator sets, pumps, compressors, fans and other machines with similar operating characteristics.



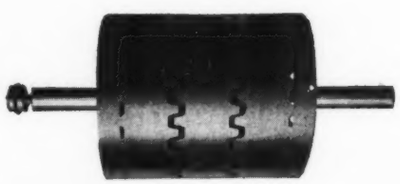
There are no bearing points in these couplings which operate without need of lubrication and without friction

Copper Alloy Gives Fine Finish

CONTAINING copper, zinc and silicon, the new "Doler-Brass" developed by Doehler Die Casting Co., 386 Fourth avenue, New York, is especially adapted to the die casting process and results in a fine finish when cast. This alloy, available in die cast form to the designing engineer together with other alloys of the company, has physical properties which include the following: Tensile strength, 65,000-75,000; yield point, 30,000-40,000; elongation, 20-25 per cent in 2 inches; reduction area, 20-25 per cent; brinell hardness 110-120; impact strength, 30-36 foot pounds; color, light yellow.

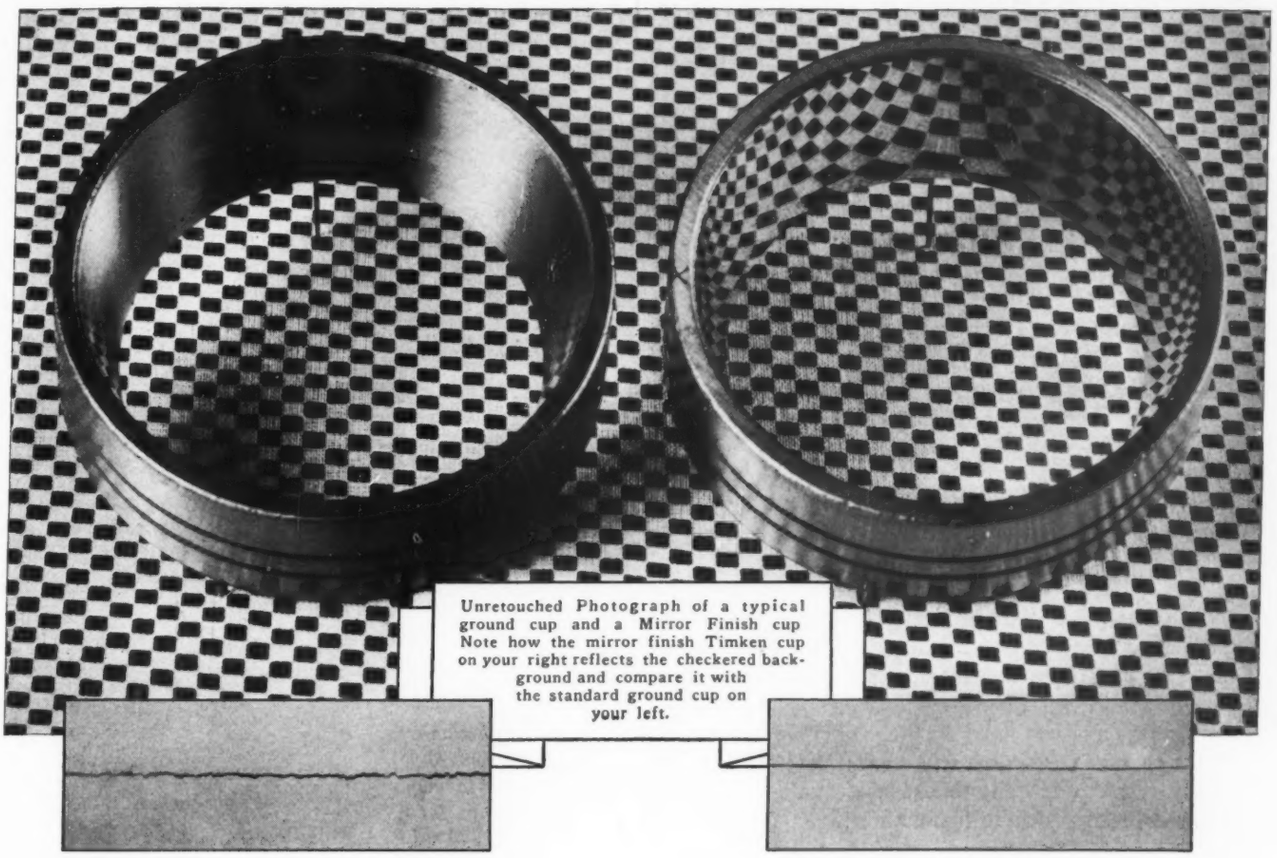
Magnetic Pulleys Dissipate Heat

TRANSVERSE and longitudinal radiating ducts aid in the dissipation of heat in the new magnetic pulley of Dings Magnetic Separator Co., Milwaukee, Wis. Each coil of the pulley, shown herewith, is wound upon its own bobbin, which forms the core and the two poles. Separate bobbins are mounted upon the pulley shaft, each bobbin being keyseated to the shaft. A



Transverse and longitudinal ducts aid in dissipating heat in magnetic pulley

Now "MIRROR FINISH" BEARINGS



Unretouched Photograph of a typical ground cup and a Mirror Finish cup Note how the mirror finish Timken cup on your right reflects the checkered background and compare it with the standard ground cup on your left.

Contact surface of standard Timken Bearing as recorded by the "Profilograph". Magnification 500 to 1.

Timken "Mirror Finish" surface as recorded by the "Profilograph" with the same magnification.

another Revolutionary Development Pioneered

by TIMKEN

Timken pioneered the tapered roller bearing 37 years ago. Timken pioneered in producing its own steel for Timken Bearings. Timken pioneered positively aligned rolls. Timken pioneered the electric sound test which made possible bearings of extreme precision and quietness. Now Timken has pioneered another advancement that is destined to revolutionize all previous conceptions of anti-friction operation — Timken "MIRROR FINISH".

Imagine a surface finish of such fineness that you could see to shave in it—cleanly and safely—and you will have an idea of what Timken "MIRROR FINISH" really means.

All who have seen this new finish—and especially those most familiar with finely-ground surfaces as they have been known in the past—are amazed at the results that have been obtained.

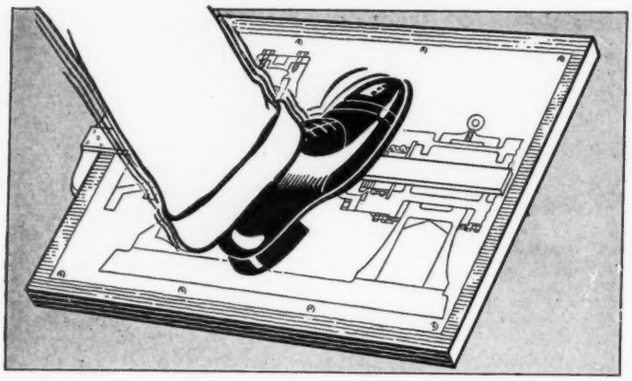
Timken "MIRROR FINISH" is the culmination of years of exhaustive research and experiment in improving grinding processes, materials and machines. Its development began shortly after the introduction by Timken of the revolutionary sound test, and reached its present perfection with the invention of the Timken-pioneered "Profilograph", the only instrument in the world capable of measuring surface smoothness to within one millionth of an inch. Timken "MIRROR FINISH" is already being applied to some sizes of Timken Bearings. It will be applied to our entire production as soon as the necessary special equipment can be manufactured and installed.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN *TAPERED ROLLER* BEARINGS

COPYRIGHT 1935 BY THE TIMKEN ROLLER BEARING COMPANY

WE *Stepped in* AT THE **PACKING POINT***



TO KEEP ACCURACY FROM STEPPING OUT

The fact that exact centering was imperative to the accuracy of a certain measuring device had apparently been overlooked by the manufacturer.

But Graton & Knight engineers, naturally more experienced in the ways of packings, saw immediately from the blueprint submitted that the packing requested would not do the job.

So they called for the parts of the assembly—found that by redesigning the packing it could always be made to center exactly. From their study, a Graton & Knight leather packing was developed that invariably centered perfectly in production.

STOPPED AT THE PACKING POINT?

Let Graton & Knight show you where and how the particular problem at your "Packing Point" can be solved. Special packing leathers, laboratory-tested at the Home of Research by Graton & Knight Engineers, are ready to meet such conditions as heat, water, oil, air, semi-corrosive liquids, etc. Prove the superiority of leather for packings to your own satisfaction by writing or wiring for Graton & Knight Leather Packings.

THE "PACKING POINT"** is the point in the design of a machine where the problem of packing enters—the point where, we suggest, you consult **The Home of Research.

"Creating Success at the Packing Point"

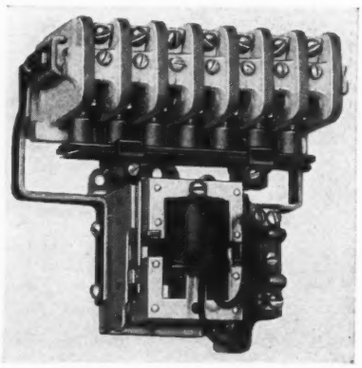
2104

maximum radiating surface is presented by corrugations on the inner and outer faces of the bobbin, air passing through the radial and longitudinal openings.

Each pulley is supplied with coil covers of heavy bronze to eliminate short circuiting of the lines of force between the two poles. Also included are set collars, bronze collector rings with double contact brushes for each collector ring, dustproof collector ring housing and approved steel switch cabinet in which is mounted a pilot lamp with bullseye indicator to show when current is flowing, fuse, switch and special kick-absorbing resistance to absorb counter EMF.

Contactors May Be Combined

A COMPACT new multiple magnetic contactor, designated as Size 0 and rated 2 horsepower, has been announced by General Electric Co., Schenectady, N. Y. It is intended for use either with small single phase and polyphase alternating current motors, or as a flexible re-



New contactors may be controlled remotely through pushbutton stations, limit switches or other pilot devices

laying device for complicated control systems, such as are used on machine tools.

The new contactor, shown herewith, is available with either normally open or closed contacts, or with a combination of both. It may be controlled remotely through pushbutton stations, limit switches, or other pilot devices. Any two forms of the contactor may be combined and mechanically interlocked either vertically or horizontally. A self-contained device, it is easily installed, and can be mounted either as an open type contactor or as an enclosed switch, for it is also obtainable with enclosing cases. The latter are compact and round cornered with conveniently located knockouts.

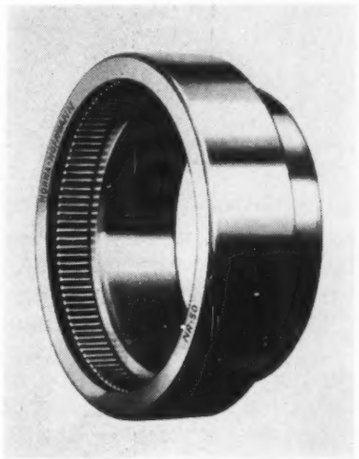
Coatings Are Nonporous

FILMS formed by the new coatings being manufactured by Technical Coatings Inc., 11 Park Place, New York, are said to be free from

porosity and impervious to water and corrosive atmospheric gasses. The coating vehicle is described as a combination of pure vegetable gums and heat-treated oils. It contains no linseed oil or synthetic resins and forms elastic films which are air and watertight. Primers with the new nonporous base are available for various purposes. These include metallic zinc, a combination of zinc and aluminum and a balanced red lead. Finish coats in standard colors are also available.

Offers Needle Roller Bearings

NEEDLE roller bearings, widely used for cam rollers, planetary reduction gears, valve rocker arms, pump shafts, idler gears and many other applications are now being marketed by Norma-Hoffmann Bearings Corp., Stamford, Conn. Due to the use of long rollers of small diameter, the bearing, shown herewith, can be employed in positions where considerations of space make the use of standard ball and roller bearings impracticable. They are used for applications where minimum weight and highly concentrated load capacity are requisites.



Needle bearings are designed for use where space considerations make standard designs impractical

The bearing consists, essentially, of one or more rows of long rollers of small diameter, packed between suitable surfaces or raceways. No cage or spacing device is used to prevent mutual contact between the rollers or to guide them in the raceways. The clearance between roller and roller is kept to a minimum to avoid any tendency for the rollers to skew.

Pushbuttons Protect the Operator

WATERTIGHT pushbutton master switches in a new line, mounted in molded phenolic-compound enclosures and intended for naval type istallations or equivalent industrial appli-

WRITE FOR IT . . .

It gives you in one handy file, a set of samples of the many types of felt . . . together with chart showing applications of each type and grade. Standard file size . . . developed to be useful to you; not to sell you. We'll gladly mail you one no matter what felt you use.

THE BOOTH FELT CO., Inc., 444 19th St., Brooklyn, N. Y.

Booth
PRECISION CUT FELT

593

"Type 2000" Ozalid Developing Machine

FOR THE FIRST TIME in the History of Technical REPRODUCTION PROCESSES

transparent duplicates of tracings can be made on transparent paper or cloth in your own blue printing department and in but two steps—exposure and dry development.

All Ozalid prints are developed dry and are true to scale. No washing or developing tanks nor drying machines are necessary.

Ozalid produces results which have been sought for, for more than thirty years. Get the complete story. Mail this "ad" today.

OZALID CORPORATION

354 MD Fourth Avenue New York, N. Y.

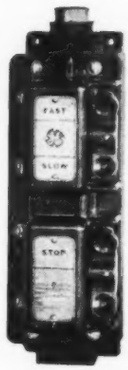
Send us the complete story

Name .....

Address .....

By .....

cations have been introduced by General Electric Co., Schenectady, N. Y. Each unit, shown herewith, is operated by a molded lever, thus protecting the operator from electrical contact with any metallic parts that might be "alive," and as many as four units can be mounted in one enclosure. The units, designated as CR2940 master switches, provide both normally open and closed circuits. Either momentary contact units or a combination of momentary contact and latched-in units are available.



Molded phenolic-compound enclosures protect pushbutton master switches from water and other liquids

Introduces Improved Welding Cable

DESIGNED to meet conditions of extremely severe wear and abrasion, a new type of welding cable known as "Realwear" is being offered by Lincoln Electric Co., Cleveland. This cable consists of fine tinned copper wire laid in ropes and stranded. Individual ropes are alternated in succession as regards the direction of the lay to prevent distortion in applications of severe usage. The conductor is insulated with an especially developed rubber compound to provide firm adhesion between the cover and rubber insulation.

Can Build-In Drum Switches

TWO LINES of rotating drum switches, one for multispeed and the other for reversing applications, are a recent development of General Electric Co., Schenectady, N. Y. Designated as CR3300 drum switches, they are easily installed and can be either wall or flange mounted for built-in applications.

The reversing switches have a self-locking cam for positioning, but are easily adjusted for spring return or for maintaining contact in either position. They are suitable for single, two or three phase, reversing or nonreversing, and for two-speed nonreversing motors where an off-position contact is not required.

The multispeed switches are particularly suited for built-in applications. Two, three and

four speed, constant torque or constant horsepower, and variable torque or variable horsepower switches are all furnished with an off-position contact.

Bearings Are Self-Aligning

A NEW line of bearing units, which are to be known as Link-Belt Shafer self-aligning roller bearing "series 400" have been introduced by Link-Belt Co., 910 South Michigan avenue, Chicago. In the design, Shafer self-aligning double row bearings are used in Link-Belt mountings. The units, shown herewith, are

Concave rollers provide self alignment in bearing units for pillow blocks, flange bearing hangers and take-ups

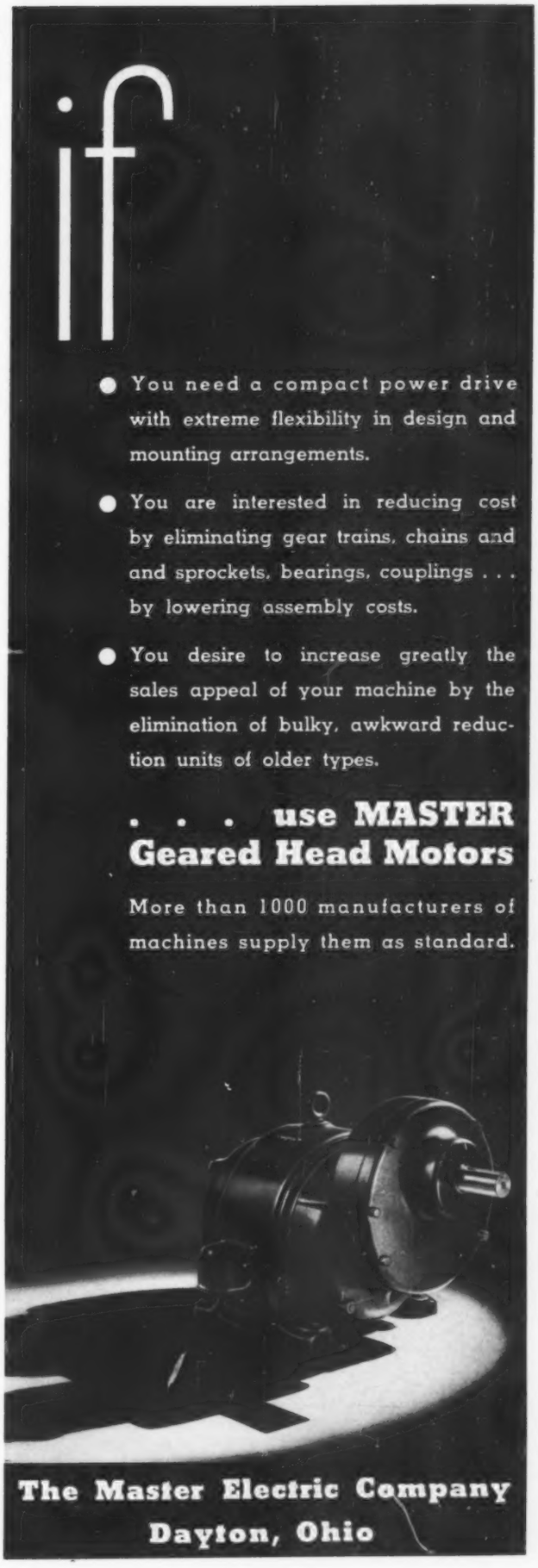
available for pillow blocks, flange bearings, hangers and take-ups. Self-alignment of the roller bearings is provided by concave roller between convex outer races and a spherical inner race on the sleeve, which is free to deflect with a shaft temporarily misaligned or out of line because of inaccuracies in installation. Labyrinth seals protect the bearings.

Controllers Are Redesigned

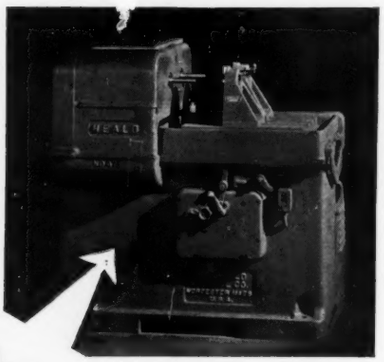
ESPECIALLY suited to the majority of automatic control applications, a new instrument to be known as the Tag No. 40 controller has

Controlling mechanism has been redesigned for compactness in new line of instruments

recently been put on the market by C. J. Tagliabue Mfg. Co., Park & Nostrand Aves., Brooklyn, N. Y. The principle of control is basically


if
You need a compact power drive with extreme flexibility in design and mounting arrangements.
You are interested in reducing cost by eliminating gear trains, chains and and sprockets, bearings, couplings . . . by lowering assembly costs.
You desire to increase greatly the sales appeal of your machine by the elimination of bulky, awkward reduction units of older types.
. . . use MASTER Geared Head Motors
More than 1000 manufacturers of machines supply them as standard.
The Master Electric Company
Dayton, Ohio

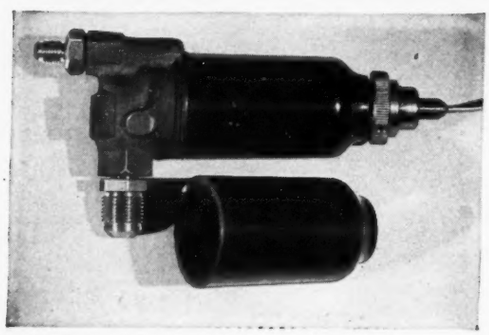
HEALD Uses PULLMORE CLUTCHES



The Heald Machine Co., of Worcester, Mass., uses Pullmore Clutches in their Bore-Matic Precision Boring Machines, one of which is shown above. A No. 3 Double Pullmore, running in oil, is used in the spindle drive. One side of the Clutch starts and drives the spindles, the other side acts as a smooth powerful brake when the spindle-drive is disengaged. This Pullmore application is "working out very satisfactorily". Made in Single and Double types, many sizes, for operation in oil or dry; Pullmore Clutches are ideal for transmitting and controlling up to 75 H.P. at 500 r.p.m. in any type of machinery. Investigate!

ROCKFORD DRILLING MACHINE CO.
304 Catherine Street, Rockford, Illinois
Sold by MORSE CHAIN CO., Ithaca, N. Y.
With offices in principal cities

● ANOTHER JOB by CHICAGO MOLDED PRODUCTS CORP.



MOLDED PLASTIC HOUSINGS

The plastic molded housing of this thermostatic expansion valve was produced by Chicago Molded Products Corporation for the American Injector Company of Detroit.

The American Injector Company is one of hundreds of firms who have brought their difficult engineering problems to this organization. Here they find intelligent appreciation of their needs; engineering skill to work out the correct solution; and unequalled facilities for the production of molds and molded pieces. These factors have combined to make Chicago Molded Products Corporation the recognized headquarters for plastic molding in the Middle West.

We can serve you best if permitted to work with you in the development of your idea from its inception. If you are considering the possibility of using plastics, you are invited to consult us without obligation.

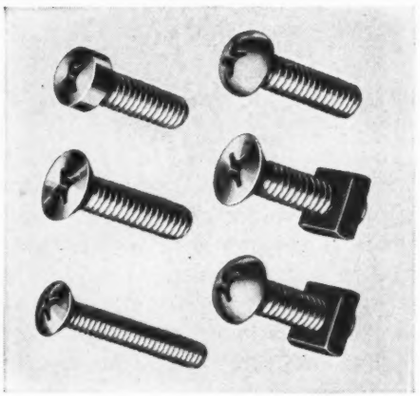
CHICAGO MOLDED PRODUCTS CORP.
2147 Walnut Street Chicago, Illinois

the movement that has been used by the company for many years. It has been redesigned for compactness in such a fashion that the few simple parts are easily accessible.

A novel spring lever designed to eliminate all lost motion multiplies the movement of the powerful capsular spring for sensitive yet positive control. The smallest change in temperature is transmitted positively and with precision to the ball air valve which in turn resets the rate-of-flow through the diaphragm actuated control valve. Indicating and nonindicating types in nine temperature ranges and three pressure ranges are available in this new controller.

Screws Have Tapered Slots

A TAPERED recess, which exactly fits a tapered driver, takes the place of the conventional slot in the line of machine screws being introduced by American Screw Co., Providence, R. I. The greater strength of the head in these screws makes it possible to set them up tighter without danger of breaking the head. They hold on the point of the driver, and may be brought into position with one hand, thus simplifying assembly. The self-centering feature prevents the driver from slipping sideways, and provides much greater purchase between the driver and the screw.



Tapered slots in screw head provide a greater bearing surface for the screw driver and facilitate assembly

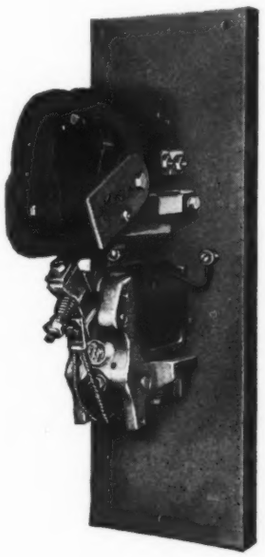
Announces Improved Brake Lining

A NEW type of brake lining, called BX Woven, for use on heavy industrial machinery and equipment is a recent development of Thermoid Rubber Co., Trenton, N. J. This brake lining has as its base asbestos tape that is woven in a single thickness and therefore has no plies to separate under severe service conditions. This tape is woven of heavy yarn containing brass wire and is impregnated with a highly heat-resistant Bakelite resin. The resultant product is

a dense flexible material consisting of 70 per cent asbestos and 30 per cent resin. It is ground on the wearing surface, ready for applications.

Contactors Confine the Arc

FOR USE on mill, crane machinery controllers, and other direct current applications, Electric Controller & Mfg. Co., 2698 East Seventy-ninth street, Cleveland, has brought out a complete line of new magnetic contactors up to and including 800 ampere capacity in which the arc, formed as the circuit is opened, is ruptured harmlessly in a narrow path or line centered between, but not touching the arc shields. Line-Arc contactors, shown herewith, are made of a strong aluminum alloy with magnetic parts of rolled steel which gives the advantage of light weight and low inertia of moving parts, permitting quick response and high speed operation. Operating coils are designed for continuous operation on direct current voltages of 230 volts or less.



The arc formed as the circuit is opened is ruptured harmlessly in a narrow path or line centered between the arc shields in new contactor for direct current applications

As the contacts on these new contactors start to separate, the arc is immediately removed from the contact tips. One end of the arc travels rapidly up the circular copper guard over the blow-out coil and the other end moves in the opposite direction along a horizontal arcing plate located between the front of the arc shields. In this manner the arc is stretched out in a narrow path or line between, but not touching the arc shields.

Cast-Machined Pulleys Introduced

PULLEYS of cast-machined (semisteel) construction for use in conjunction with its cog-belt drive for all ratings up to 15 horsepower

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• • • HERE'S THE SIMPLE WAY
TO HAVE INSTANTLY
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The trouble with a blue print is that it's a negative. The picture it shows is in reverse. Compare a blue print with a BLACK AND WHITE Print—sharp, black lines on a white background—and you'll be amazed at the instant clarity of the BW Print. No wonder BW Prints are making blue prints obsolete in so many plants today!
BW Prints present a true picture of your plans and designs—allow individual parts to stand out in their true relation. In the plant and in the shop they are always easy to understand. Corrections made with pen, pencil or crayon are never overlooked.
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SENSITIZED PAPERS . . . REPRODUCTION PROCESSES . . .
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NEW YORK CHICAGO DETROIT NEWARK PITTSBURGH
ST. LOUIS LOS ANGELES BOSTON SAN FRANCISCO MILWAUKEE

THE TAPERED EDGE

SEALS WITH MINIMUM FRICTION

The tapered edge of the leather washer is a vital feature of the Gits Precision Oil Seal.

The leather is so flexible at this tapered edge that only a slight pressure of the flat spring clamp ring, located at this point, is required. Friction on the shaft is therefore reduced to a minimum. Moreover this sharp tapered edge prevents the escape of oil by shearing the oil film.

Send for a descriptive folder.

GITS BROS. MFG. CO.
1861 So. Kilbourn Ave., Chicago, Ill.

GITS Precision Oil Seal

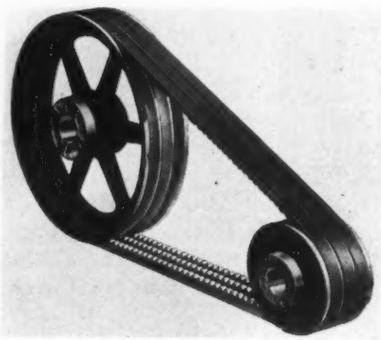
WHAT'S *the* DIFFERENCE

OHIO SPEED REDUCERS

The cut of a suit . . . the streamlining of a car . . . the design of your own product—each takes a different form of specialized skill. The same is true of speed reducer design; no two drive problems are identical. We build planetary, worm, herringbone and special design reducers; each as well built as long and practical experience enables us. That is why Ohio Forge & Machine Corp. reducers have earned a reputation for outstanding performance—and why you can count on better service from them.

OHIO FORGE *and* MACHINE CORP.
Successor to GEARS & FORGINGS INC.
CLEVELAND, OHIO
OHIO

have been introduced in a complete new line by Dayton Rubber Mfg. Co., Dayton, O. These new units, shown herewith, are so formed as to be of maximum strength with elimination of all excess metal, thereby providing units of approxi-

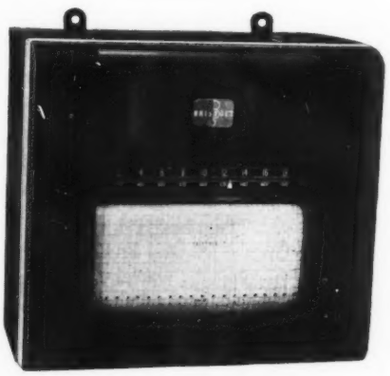


Cast steel pulleys provide necessary strength for V-belt drives

mately the same weight as the pressed steel pulleys. Accurate balance insures a true-running drive. The company will continue to offer its pulleys in the pressed steel type with the same diameters as the cast-machined units in addition to the new line of pulleys.

Employs Stainless Steel Lead Screw

WIDE-STRIP pyrometers, available in single record, multiple record and recorder controller types have been announced by Bristol Co., Waterbury, Conn. A stainless steel lead screw, operated by an electrical motor under the direction of two galvanometer-controlled contacts, adjusts the slide-wire contact and re-



Electromotive force balance is maintained in pyrometer by two galvanometer-controlled contacts

cording-pen unit to maintain electromotive force balance in the potentiometer system. This mechanism introduces a new principle of operation into temperature measurement by means of the potentiometer method. All mechanical backlash is taken up, making it possible to magnify scarcely perceptible deflections of the galvanometer pointer.

MANUFACTURERS' PUBLICATIONS

BEARINGS—A wide diversity of applications of ball, roller and thrust bearings in machine spindles, drills, milling machines, drilling and boring machines, grinder spindles, lathe headstocks and centers, routers and loose pulley mountings are shown in blueprint form in a new bulletin of Norma-Hoffmann Bearings Corp., Stamford, Conn. The details of mounting and assembly are depicted clearly, enabling use of the drawings when considering new applications.

BEARINGS—The needle roller bearing, what it is, how it may be applied, and a complete table of sizes and load ratings are presented in a recent folder of Norma-Hoffmann Bearings Corp., Stamford, Conn.

BEARINGS—Link-Belt Co., Chicago, is distributing book No. 1494 giving complete details on the Link-Belt Shafer series 400 self-aligning roller bearing units. Pillow blocks, flanged units, hanger designs, and take-up units are covered in the booklet which gives sizes and capacities.

BEARINGS—An attractive photographic review of the major steps in the manufacture of ball bearings has been prepared by Fafnir Bearing Co., New Britain, Conn. The steps illustrated in the brochure include forging and machining of rings, cold forming of balls, hardening, facing, grinding, matching and inspection.

BEARINGS—SKF Industries Inc., Philadelphia, has prepared a comprehensive bulletin on the design of spindle mountings which shows in cross-sectional form a number of successful applications. Each mounting is described and the advantage of each particular arrangement is given. The company has also prepared a number of catalog inserts on spindle mountings which give the design and details on the rigidity, accuracy and efficiency.

BRASS—Doler-Brass die castings, fabricated from a new alloy containing copper, zinc and silicon and resulting in a fine finish, are presented in a publication of Doehler Die Casting Co., New York.

CAST PARTS—As the first of a series of folders on zinc base alloy die castings, Apex Smelting Co., Chicago, has prepared "Metalgram No. 1" which includes a series of charts giving the tensile strength of the die cast alloy when cast at varying temperatures in connection with differing die temperatures and pressures.

CAST PARTS—Data required for the estimation of costs of malleable iron castings is given in a recent pamphlet of Lake City Malleable Co., Cleveland, O. The pamphlet shows the kind of data which should always be supplied by the user of castings to assist the manufacturer in developing the right kind of patterns required to make satisfactory castings.

CAST PARTS—The complete story of the development

The name BALDOR

and its accomplishments

15 Years specialized experience in designing and producing the finer motors exclusively.

15 Years steady growth of the company due to its high quality standard, its fair prices and square dealings with its customers.

WRITE

Latest Bulletins containing complete Technical Data on motors, specifications and other helpful information, sent upon request.

The BALDOR *Line Includes:*

SINGLE PHASE—Repulsion Induction	⅛ to 7½ H. P.
Capacitor Type	1/30 to 1½ H. P.
Split Phase	1/30 to ½ H. P.
DIRECT CURRENT	¼ to 3 H. P.
POLYPHASE—Squirrel Cage	½ to 15 H. P.
Double Squirrel Cage	3 to 15 H. P.
UNIT HEATER MOTORS—All Types	1/30 to ½ H. P.

Standard Horizontal and Vertical Motors for all applications. Ball Bearings in all sizes. Sleeve bearing up to 2 H. P.

BALDOR ELECTRIC COMPANY

4352 Duncan Avenue, ST. LOUIS, MO.

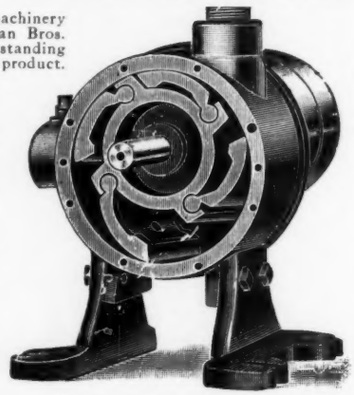
Sales and Service Offices in Principal Cities

BALDOR

A BETTER MOTOR

THE AIR PUMP THAT HOLDS OUT NEW POSSIBILITIES TO MACHINE DESIGN

The over 45 years of good machinery making experience back of Leiman Bros. Air Pumps shows itself in the outstanding performance of this nationally used product.



Leiman Bros. Positive Air Pumps have been constantly improved from the very beginning. The result is a sturdy, noiseless and powerful pump that takes up its own wear, gives constant air pressure or vacuum even after years of use—a pump that lasts a lifetime.

If you have an air or vacuum problem, you will save time and money by investigating how this pump can help you.

Write for interesting free book "New Era in Air Pumps."

26 Inches Vacuum Easy

"It may interest you to know that the writer created and maintained 26 inches vacuum using a 5-gallon tank under far from ideal conditions"—writes another user.*

Used 350 Without a Complaint

"We take pleasure in advising you that we are using your air pumps on 350 of our machines, and in no instance has this pump given a moment's trouble"—writes another user.*

12 Years Use Without Expense

One well known user* of Leiman Bros. Air Pumps in referring to the first pump purchased writes: "This pump has run 12 years without any upkeep expense except oil . . ."

24 Hours a Day Since 1915

"We wish to pay tribute to the Leiman Bros. Air Pump," writes another user.* "We have one in almost continuous operation (24 hours per day) since 1915—3 pounds air pressure. It is as near noiseless as any pump can be and absolutely reliable in every respect."

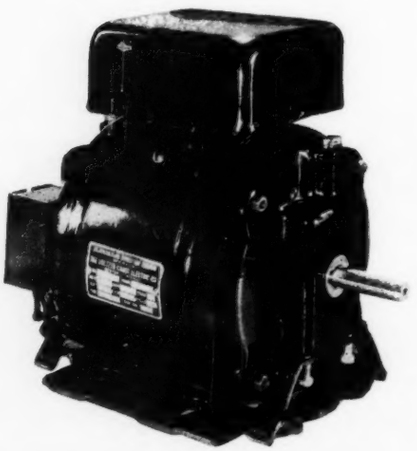
*Names of the above users and hundreds of others furnished upon request.

LEIMAN BROS. AIR PUMPS for Air Pressure, Vacuum or Gas Pumping. They take up their own wear.

LEIMAN BROS., INC.

177 Christie St., Newark, N. J.
LEIMAN BROS. New York Corp., 23 Walker Street
Makers of Good Machinery for Over 45 Years

HOLTZER-CABOT MOTORS



Manufacturers of motor driven apparatus and appliances have found HOLTZER-CABOT Motors built to fit the job, give best results.

Our engineers have a wealth of experience. Let them shoulder your motor problems.

Write Dept. 14 for bulletin.

HOLTZER-CABOT ELECTRIC CO.

Motor Specialists for 50 Years

125 AMORY ST. BOSTON, MASS.

of zinc alloys for die castings is told in technical form in the booklet "Zamak Alloys for Zinc Alloy Die Castings," prepared by New Jersey Zinc Co., New York. Included in the booklet are complete details on the alloys available, data on the finishing of the die castings and similar engineering information. Another booklet of the company gives a visual report of progress of zinc alloy die castings. This well-prepared photographic presentation indicates the many problems that have been solved with the die castings and suggests new solutions.

CONTROLLERS—C. J. Tagliabue Mfg. Co., Brooklyn, N. Y., is distributing a folder on its No. 40 controller which has been redesigned for compactness so that the parts are accessible with exceptional ease.

CONTROLLERS—Construction and ease of adjustment obtainable with air-operated controllers is given in catatog No. 8900 of Brown Instrument Co., Philadelphia. The controllers are for the control of temperature, pressure, flow and liquid level.

CONTROLLERS—Foxboro Co., Foxboro, Mass., has published bulletin No. 202 covering its complete line of potentiometer and resistance thermometer controllers for handling practically every problem of industrial high temperature control.

CONTROLS (ELECTRICAL)—Ward Leonard Electric Co., Mount Vernon, N. Y., has prepared a number of catalog inserts on manual starters, speed regulators and rectifiers.

CONTROLS (ELECTRICAL)—Line-arc magnetic contactors for use on mill, crane machinery controllers and other direct current applications are described in a folder of Electric Controller & Mfg. Co., Cleveland.

CONTROLS (ELECTRICAL)—Direct current contactors of 600 volts, 150-2500 amperes capacity are covered in bulletin GEA-2227 of General Electric Co., Schenectady, N. Y. Illustrations show the parts used in the contactors while a detailed description of each and of the operation is given.

COUPLINGS—John Waldron Corp., New Brunswick, N. J., has prepared a folder giving a cross-sectional view and complete details on its line of cross type couplings.

COUPLINGS—Thomas Flexible Coupling Co., Warren, Pa., is distributing a well-prepared booklet on its line of flexible couplings which eliminate backlash. All types of the couplings employ flexible laminated heat treated disk rings for the transference of the torque and the assurance of flexibility.

DESIGN DEPARTMENT—Paragon-Revolute Corp., 77 South avenue, Rochester, N. Y., has issued a new 16-page illustrated booklet describing its latest model of improved continuous printing, washing and drying machine. In the design the tracings rotate around the arc lamps.

DRIVES—Reeves Pulley Co., Columbus, Ind., is distributing a folder which describes the application and advantages of infinitely variable speed transmissions to a number of types of machine tools.

DRIVES—Diehl Mfg. Co., Elizabethport, N. J., has prepared a folder on its new line of gearmotors which includes helical gear or worm gear units, either direct connected or coupled types, in single, double and triple re-

ductions for horizontal, vertical and right-angle drives.

DRIVES—Selection of the correct chain drive is considerably simplified by a valuable Selector devised by Morse Chain Co., Ithaca, N. Y. This Selector takes the "mystery" as it were, out of silent chain drive designing as it enables selection within the range of ½ to 150 horsepower. It selects the number of teeth in the sprockets, pitch and width of the chain, gives the standard center distance, figures the chain length, gives the diameters of the sprockets and indicates the sizes which are carried in stock.

DRIVES—Variable speed transmissions manufactured by Lenney Machine & Mfg. Co., Warren, O., are covered in a recent publication of the company. The units are infinitely adjustable to a fraction of a revolution per minute.

GEARS—The theory of gear generation, with particular reference to the Sykes process and its advantages as compared with others, is given in a 52-page book on gear generators, essentially a condensed treatise on gear manufacture, published by Farrel-Birmingham Co. Inc., Buffalo, N. Y.

HEATING UNITS—Details on strip and immersion electric heating units are presented in a new folder of Harold E. Trent Co., Philadelphia.

INSULATING MATERIALS—Insulating materials as related to the problem of insulating modern industrial equipment, refractories and transite in its various forms are a few of the products described in a comprehensive catalog of industrial products which has just been published by Johns-Manville, New York.

MAGNESIUM—Dowmetal, industry's lightest structural metal, the various forms available, and the properties of the alloys, is presented in a new folder of Dow Chemical Co., Midland, Mich. The booklet includes photographs of typical parts made of die castings, sheets, forgings and castings.

MOTORS—General Electric Co., Schenectady, N. Y., has prepared catalog insert GEA-246D giving complete details on its line of high-speed synchronous motors.

MOTORS—Reliance Electric & Engineering Co., Cleveland, is distributing bulletins 118 and 119 on its line of squirrel cage induction motors. Data include details on the construction of the motors, typical uses and performance characteristics.

PLASTICS—A complete though concise presentation of plastic materials, their advantages and limitations is given in a well-prepared booklet of Reynolds Molded Plastics, Jackson, Mich. Materials covered include Bakelite, Durez, Tenite, Plaskon, Beetle and Resinox, with description, characteristics, physical properties and applications of each being presented.

PLATES—A 362-page ready-reference handbook for designers, engineers and consumers of steel plates and flanged-plate products, bound in fabrikoid, has been published by Bethlehem Steel Co., Bethlehem, Pa. The volume provides in one place all the necessary working data, such as tables, specifications, general engineering and metallurgical information on steel plates, flanged products and tubes. Data presented includes: Rivet informa-

CONTROLLED

CHEMICALLY and PHYSICALLY

Designed and Constructed from Modern Engineering Knowledge

Supertan Mechanical Leather Packings are not just packings. They are highly specialized, technically designed packings. Every operation and process in their manufacture is absolutely controlled and held to fixed standards from hide to finished product.

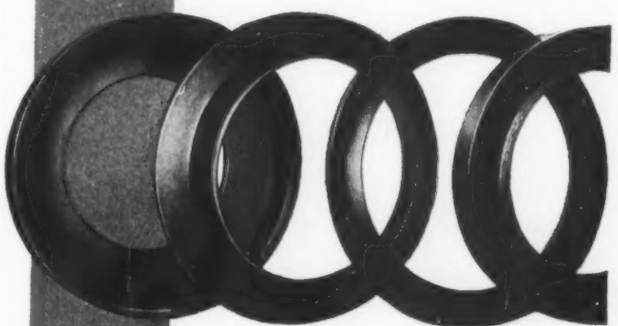
They are designed from modern engineering knowledge. Definite chemical treatments are applied—treatments that are based on an exact knowledge of the chemistry required for all kinds of applications and service conditions. Scientific methods of forming are used—multi-stage moulding—leather accumulation and concentration at points of greatest stress and wear—methods that impart the greatest sealing ability and longest life to the finished packing.

Loss of time, money, and production result from inferior packings in any machinery or equipment; tearing down is costly—many times the price of good packings. They can be reduced to a minimum with Supertan Mechanical Leather Packings.

A real consulting engineering service on packing applications for all kinds of hydraulic, pneumatic, and vacuum operated equipment is available for the asking—and highly interesting facts about how Supertan Packings are better packings. There is no obligation.

P-101A

MICHIGAN LEATHER PACKING CO.
724 Fourteenth Avenue, Detroit



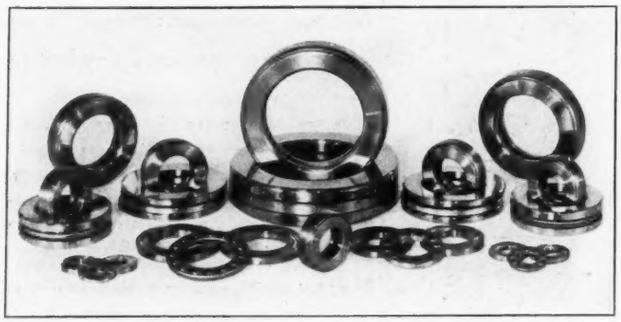
Write for Bulletin 301

Supertan

MECHANICAL LEATHER PACKINGS

BANTAM

Ball Thrust Bearings



Carried in stock in five types and a wide range of sizes. Our facilities for the production of hardened and ground ball thrust bearings of standard or special sizes from ½″ to 60″ are unequalled. Write for Catalog.

THE BANTAM BALL BEARING CO.
SOUTH BEND, INDIANA

Trade Mark Reg.

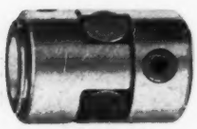
Chicago, New Orleans, Dallas — Youngstown, Philadelphia, Seattle — Detroit, Pittsburgh, Toledo — New York, Rochester, N. Y., Washington, D. C.

BBB ONE OR A HUNDRED MILLION 1/32″ TO 60″

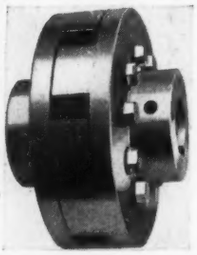
Changes Improve Performance

L-R
FLEXIBLE COUPLINGS

TYPE IAU



TYPE IA



TYPE P

(U.S. & Foreign Patents Pending)

3 types meet practically every condition and requirement in flexible coupling service.

L-R FLEXIBLE COUPLINGS have been changed and now their performance is improved. Life of resilient spider of TYPE "IAU" (½″ dia. or less) and TYPE "IA" (¼″ to 3″ bores) has been increased 50% by the new convex or flaring jaw surface construction.

TYPE "P" (3″ to 10″ Shaft Dia. at 18 to 1500 H. P. at 100 R.P.M.) is different, more efficient, more economical than any other coupling made. Load cushions are free-floating and hang between jaws on removable studs. Cushions are always in plain sight and can be quickly and easily removed without tearing down coupling.

L-R Flexible Couplings are EVERLASTING — they do not transmit power from metal to metal directly — they require no lubrication.

Engineering data and test samples available. Just send H. P., R. P. M. and Shaft Dia. Write

LOVEJOY TOOL WORKS 5018 WEST LAKE ST. CHICAGO, ILLINOIS

tion; specifications on angles; dished heads; welding of boilers; and many other related subjects.

STEEL TREATING—Chapmanizing, what it is and how it hardens steels is related in an attractive booklet of Chapman Valve Mfg. Co., Indian Orchard, Mass. The booklet gives examples of what has been done with the hardening process.

WELDED PARTS AND EQUIPMENT—The use of lightweight welded crankcases and bases to radial diesel engines and how these parts are fabricated is covered in a folder of Lukenweld Inc., Coatesville, Pa.

WELDED PARTS AND EQUIPMENT—Lincoln Electric Co., Cleveland, has prepared a 36-page booklet on arc welding electrodes which includes a presentation of the principle of the shielded arc, and complete details on each of the electrodes in the line. Another booklet prepared by the company gives an authoritative discussion of automatic arc welding by the electronic tornada. Topics covered include the theory of the welding process, typical applications and how they have been accomplished.

Research Publications

Predicting the Strength of Structures from Tests of Plaster Models, by Raymond J. Roard and Richard S. Hartenberg. The best way to ascertain the strength of a structure is to test the structure itself, or a duplicate, to failure under conditions as nearly as possible identical with those of service. This is usually difficult and expensive, and often impracticable. As a substitute measure, the test of a scale model made of some weaker and more easily fabricated material suggests itself. This booklet outlines the methods used in testing plaster models, how these models are prepared, how the results are translated to the material to be used in the structure, and the results of several tests. Published as Engineering Experiment Station Series No. 81 by University of Wisconsin, Madison, Wis. 51 pp. 25 cents.

Stress Concentration at Fillets, Holes and Keyways as Found by the Plaster-Model Method, by Fred B. Seely and Thomas J. Dolan. Model tests are made to supplement the purely mathematical method of analysis, or to obtain a solution, often approximate, for the stresses in a number when a mathematical analysis is not possible or feasible. From a material that is brittle, and that has a nearly straight stress-strain diagram up to its ultimate strength, a model is made of the member of irregular shape in which the stress is to be found; from the same material is also made a specimen of simple shape in which the stress due to a given load can be computed satisfactorily. The specimen of simple shape and the model of complex shape are then tested to destruction. The test of the simple shape gives approximately the ultimate tensile strength of the material, and the test of the model gives, with a fair degree of accuracy, the load which produced the same ultimate stress in the most highly stressed fiber of the model. From these values the relation between load and maximum tensile stress in the model of irregular shape is obtained. Available as bulletin No. 276 from Engineering Experiment Station, University of Illinois, Urbana, Ill.

Business and Sales Briefs

UDYLITE CO., Detroit, has opened a Chicago warehouse at 1943 Walnut street, Chicago, for the convenience of its customers in the Chicago territory. Donald Sales & Mfg. Co., Milwaukee, has been appointed as distributor for the complete line of plating and polishing supplies, manufactured by Udylite, in the Wisconsin territory. Another distributor recently appointed by the company is Scobell Chemical Co., Rochester, N. Y.

* * *

Reeves Pulley Co., Columbus, Ind., manufacturer of variable speed transmissions and controls, has completed the third addition to its office and factory space since the first of the year.

* * *

John D. Swain has been elected as vice president of Electro Metallurgical Sales Corp., New York. Mr. Swain, who has been vice president of Linde Air Products Co. and Union Carbide Sales Co., will have offices in the Carbide and Carbon building, 30 East Forty-second street, New York.

* * *

Pittsburgh district sales offices of Republic Steel Corp. have been removed to 1832 Oliver building. F. M. Welsh continues in charge of the office. Union Drawn Steel Co., a Republic subsidiary, has moved into an adjoining suite in the Oliver building. W. C. Gullyes, district sales manager, will be in charge.

* * *

P. E. Welton, Universal Engineering Corp., Akron, O., is now special representative of Foote Bros. Gear & Machine Co., Chicago, for the rubber industry.

* * *

Link-Belt Co., Philadelphia, has appointed T. Frank Webster as resident manager of the company's Boston office, succeeding Horace Goldstein who has been assigned to engineering sales work at the Philadelphia office.

* * *

Joseph M. Bandish has been appointed director of sales of the metallic packing division of Felt Products Mfg. Co. Mr. Bandish's office will be located at 1508 Carroll avenue, Chicago.

* * *

Frank F. Chiles, formerly manager of sales of the bar division of Corrigan, McKinney Steel Co., has been appointed assistant manager of sales of the bar division, Republic Steel Corp., with headquarters at Youngstown, O.

* * *

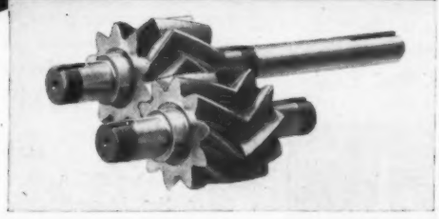
Edward L. Ryerson Jr. has been lected vice chairman of the board of directors of Inland Steel Co. Mr. Ryerson, who is president and a director of Joseph T. Ryerson & Sons Inc., was recently elected a director of the Inland company.

* * *

A. E. Heroux has been assigned to the position of gen-

Why YOU should SPECIFY ROPER Rotary Pumps

EQUAL SIZE GEARS OPERATE AT SAME SPEED



- Accurately hobbed gears keyed and pressed on to shafts.
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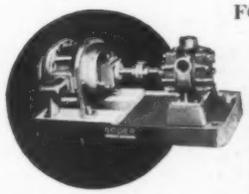
The basic design of all Roper Rotary Pumps is the simplest yet conceived . . . the result of 75 years of engineering, experimentation and experience.

Simplicity makes for efficiency, dependability and long trouble-free service as every engineer knows. Roper Pumps have earned their spurs as *Dependable* Pumps. Specify them wherever good pumps are needed.



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provide positive hydraulic (oil) drive for accumulator service, automobile lifts, elevators, machine tool feeds and rapid traverse, presses, stokers, bulldozers, snow plows, etc.

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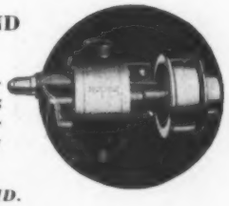
handling cutting compounds and lubricating fluids on metal working machines. One way or reversible types.



Write for Bulletin R4MD.

THE GEO. D. ROPER CORP., ROCKFORD, ILLINOIS, U. S. A.

Ask a **PUMP SPECIALIST**

about your pump problems

You'll receive the benefit of our years of experience in making hundreds of special pumps for our customers—as well as a full line of stock pumps.

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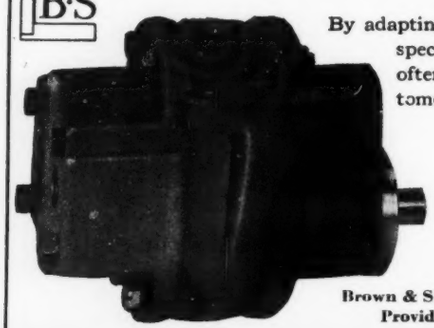

By adapting stock parts for special installation we often save our customers much expense.

Tell us your requirements.

Brown & Sharpe Mfg. Co.
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Brown & Sharpe Pumps
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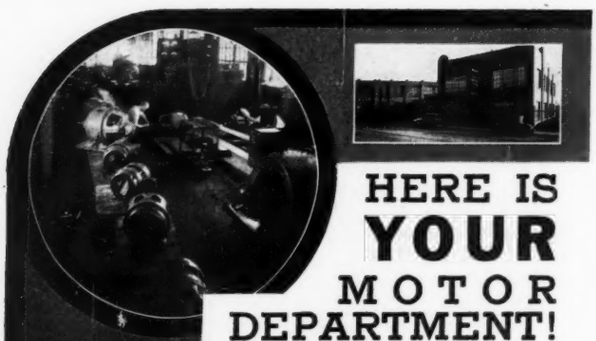

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For 46 years Imperial has specialized on giving motor users a remarkably fine product plus a personal type of service.

When you deal with Imperial you deal with the owners of the business . . . and Imperial becomes as much YOUR motor department as if the fine Imperial plant were under your own roof.

Imperial builds standard and special A.C. and D.C. motors and generators in ratings from 1 to 300 Hp.

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QUALITY · SERVICE · RIGHT PRICES
COURTEOUS TREATMENT

Imperial
Motors and Generators

eral sales of the Permite paint sales division of Aluminum Industries Inc., manufacturer of Permite products, Cincinnati. Mr. Heroux succeeds A. B. Anderson who recently resigned.

* * *

Rubber Chemical division of the du Pont Co. has announced that a new plant has been opened for the manufacture of its synthetic rubber known as DuPrene, used for packer rubbers and pump pistons, printing rollers, sealing devices and similar purposes.

* * *

Toledo Synthetic Products Inc., Toledo, O., manufacturer of Plaskon, and Imperial Chemical Industries Ltd., of Great Britain, have completed an international agreement under which the concerns have contracted to exchange all technical, commercial and other information relating to the agreement products and processes and have agreed also to grant each other free licenses under the patents of each company. The same agreement extends to Montecatini, the Italian chemical trust. A separate agreement has been signed with Canadian Industries Ltd., appointing that company sole agent for Plaskon in Newfoundland and Canada.

CROSS SECTIONS

WE DO our best to record the identification of every material that we can uncover in order to eliminate the confusion in today's multiplicity of tradenames. If you have the name of a material and want to know what it is and who makes it, contact our Bertillon department as the odds are that we'll be able to identify it for you. If, by chance, you know of one that we have not, as yet, indexed, drop us a line and we'll add a new drawer in the file.

IT SEEMS as though everyone is helping to gear up the industrial machine for high-speed production of new designs. We recently received a chain selector which considerably simplifies the selection of chain drives and will bring the work necessary to make this selection down to the vanishing point.

A new luminescent paint has sulphur of calcium as a base and provides a permanent coating.

NEARLY all designers get real enjoyment in uncovering new ideas and new ways to do things, but we don't believe anyone could get more kick out of an arrangement than the man GE tells us about. Visitors approaching his house interrupt a beam from a photoelectric cell and a large metal mutt equipped with a big raucous buzzer emits a ferocious growl. Ever since we heard of the device we've inspected every yard we entered very carefully. We're afraid we'd move so fast it would take too long to get back!

MAYBE the pessimists are right, and we are still in the depths of the depression, but how can they explain the increasingly frequent setting of new *ALL-TIME* highs in various indexes. Production of electricity has soared over even the "boom" 1929 periods. During the

week ending October 5 output totaled 1,863,483,000 kilowatts compared with the previous peak of 1,860,021,000 kilowatts for the week ended Dec. 19, 1929. By Oct. 26 the figure climbed to 1,895,817,000 kilowatts.

COLORS and color selection are two of the most difficult subjects that can be presented for study. These subjects are far too complex for a casual survey, but we've seen three comprehensive monographs which are the most complete presentation of the subject ever available. They're worth the price to anyone having the problem of color selection.

THOSE slick cars introduced for '36 certainly put the hack we drive (how about yours?) into the antique class. We're glad though that the trend is toward refinement rather than innovation. It looked for a while like the gadgets would get away from us. It's mighty hard to keep pace with those designers.

WE STILL think that some automotive designer should hook up a photocell and loud speaker so that the car would shout in soprano when 10 miles away from running out of gas, tenor when 5 miles away and deep bass when a half block is all that is left. Maybe alto and baritone could be used for shortage of oil.

VACUUM cleaner design hasn't changed in basic principle for many years, but it looks as though the cylinder type of cleaner will stir up increased interests in design changes. The unit pictured in the August MACHINE DESIGN excited considerable comment and inquiry, and now a machine similar to the cylinder type is being imported. Such competition is the best possible stimulant for design.

ALL THIS development in cylinder-type vacuum cleaners gives us a chance to gloat. Way back in March we predicted that there would soon be offered a vacuum cleaner with a case of phenolic resinoid material. It took us until August to collect on the bet, but now cleaners of this type are definitely here. Have you considered plastics for your parts? They're shooting along, so now's the time to collect your design dope.

MAYBE WE'RE wrong, but it looks as though the designers were making sissies out of everybody. The China Clipper takes the seasickness out of a Pacific trip and air conditioning is taking the gasoline smell out of a bus trip. McCord has made a bus installation that is eminently successful. First thing you know somebody will bring out an automatic signalling and pick-up device for the thumbers.

ACTIVITY in plain bearing metals has been increasing at a tremendous rate as each maker attempts to corral the automotive business. Now a large maker of brass bushings has developed a high-lead bronze bearing which has proved more satisfactory than copper-lead bearings.

COMPETITION between horses and farm machinery has always been pretty severe, although up until now it has been most polite competition. But somebody has started making machines with a gas house complex. A news report tells of a unit which made a personal attack on a horse. The animal was standing near a threshing machine when a belt pulley caught his tail and yanked it off.

Properly Designed And Made

There is far more in the manufacturing of Graphited Bronze Bearings than simply grooving or drilling the part and pressing a graphite mixture into the depressions. If this type of bearing renders the service expected there are required the proper relation of bearing contact surfaces, the scientific determination of type and size of depressions, and a very carefully formulated graphite mixture.

The metallurgical and engineering research staffs of this company have studied this type of bearing exhaustively and have prepared us to supply this type of bearing at its very best — designed and made to fit the application.

The correct relation of contact surfaces varies (graphite vs bronze) depending on size, application, and load carried. It is by no means possible to so standardize this type of bearing that one design successfully meets varied requirements.

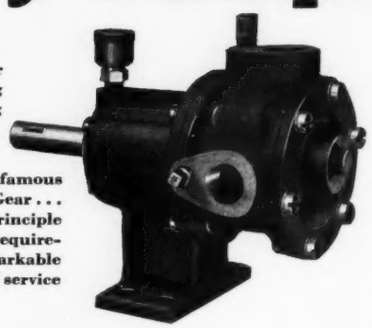
The graphited mixture employed in Bunting Bearings of this type is compounded to a special Bunting formula and hydraulically pressed into the grooving. It will not contract nor flake-out in service. It absorbs and stores oil readily when cold and when heated by shaft friction gives off oil sufficient for lubrication but without leakage at bearing ends. Designed and made as done here this type of bearing can be adopted for many applications not now satisfactorily served by the conventional product. We will gladly counsel with you on your use of this type, and quote on such requirements.

THE BUNTING BRASS & BRONZE COMPANY, TOLEDO, OHIO

Branches and Warehouses in All Principal Cities

BUNTING Bunting Quality
PHOSPHOR BRONZE
BUSHINGS • BEARINGS
MACHINED AND CENTERED BRONZE BARS

Viking Coolant
"Gear Within a Gear . . . Two Moving Parts"
Rotary Pumps



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Built-in relief rotor, eliminates the need for relief valve . . . protects the pump when discharge line is shut off. Will perform satisfactorily up to 15 foot heads or on lifts up to 15 inches vacuum. Ports are tapped and plugged to permit the changing of rotation. Each port is drilled for the "suck back" feature. Casing is fastened to bracket (which contains rotor bearing) by four equally spaced studs . . . allowing the ports to be adjusted to meet the requirements of each particular machine. Capacities of 5, 10, 15, 20 and 35 G.P.M. Write for FREE Folder, Specifications and Prices.

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Cedar Falls, Iowa

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Design for Appearance

is comprehensively treated in the 16-page bulletin by

Harold L. Van Doren

Reprinted from the February, March and April issues, this bulletin is available at 25c from

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Penton Building *Cleveland, Ohio*

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December 1935

MACHINE DESIGN

as it affects

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INSIDE

YOU FIND THE REASON

THROW open the door of a Cutler-Hammer 9586 "AAA" Motor Control and see with your own eyes the reason for its outstanding success . . . *why* it's wanted . . . specified . . . demanded by most buyers.

Its advanced engineering revolutionized small-motor control. The extent to which it has been copied proves this beyond any doubt. Its superior construction brought an entirely new standard of performance —*millions of operations*—a standard few competitive devices can approach under direct comparison. Its simplicity, its dependability, its ease of adjustment, its accuracy of overload protection . . . all the features that keen buyers seek . . . recommend the C-H 9586 "AAA" for *your* consideration. The more you investigate, scrutinize and compare, the more reason you will find for C-H 9586 "AAA" leadership in its field of service . . . and the more likely you, too, will refuse to accept any substitute for its performance. CUTLER-HAMMER, Inc., *Pioneer Manufacturers of Electric Control Apparatus*, 1310 St. Paul Avenue, Milwaukee, Wisconsin.

C-H 9586 "AAA"
N. E. M. A. Size 1

Automatic Push Button Control with Overload Protection

1 to 5 H. P., 110-220 Volts ★ 1 to 7½ H. P., 440-550 Volts

Available in all needed types, explosion-proof, dust-tight, oil-immersed, combination starter and disconnect switch, reversing starters in horizontal, vertical or back-to-back construction.

CHECK THESE EXCLUSIVE FEATURES

1. Solid silver contacts—made from bimetal billets of silver and bronze rolled to size. Not merely silver plated or spot welded silver contacts—but solid hard silver, full-area contacts that assure much longer life.

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4. The operating coil may be removed by merely bending up the clips. The 9586 "AAA" may be changed from one voltage to another in 2½ minutes.

5. The heater coil in the overload relay can be changed in less than 2 minutes to adjust for motor size. Only a screw driver or pliers is needed.

6. The entire panel of a "Triple A" can be removed for wiring by loosening only a single mounting screw.

7. Only genuine Thermoplax arc barriers such as used in heavy duty control are used in 9586 "AAA".

8. **NEW MAGNETIC LATCH** . . . Permits use of standard starter where subjected to severe shock, as on portable machines, etc. Feature pioneered by C-H now further improved. Operates on very low voltage. Long life. Foolproof.

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Triple A MOTOR CONTROL

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CENTURY SQUIRREL CAGE INDUCTION MOTORS

UP TO 600 *Horsepower*

ON particularly tough, dirty, wet jobs you will find Century Motors setting a record of continuously satisfactory performance! This statement stands on more than 30 years' proof! It is your safeguard in the selection of motors for driving your product or plant equipment — no matter what it is — no matter what severe demands are imposed upon it!

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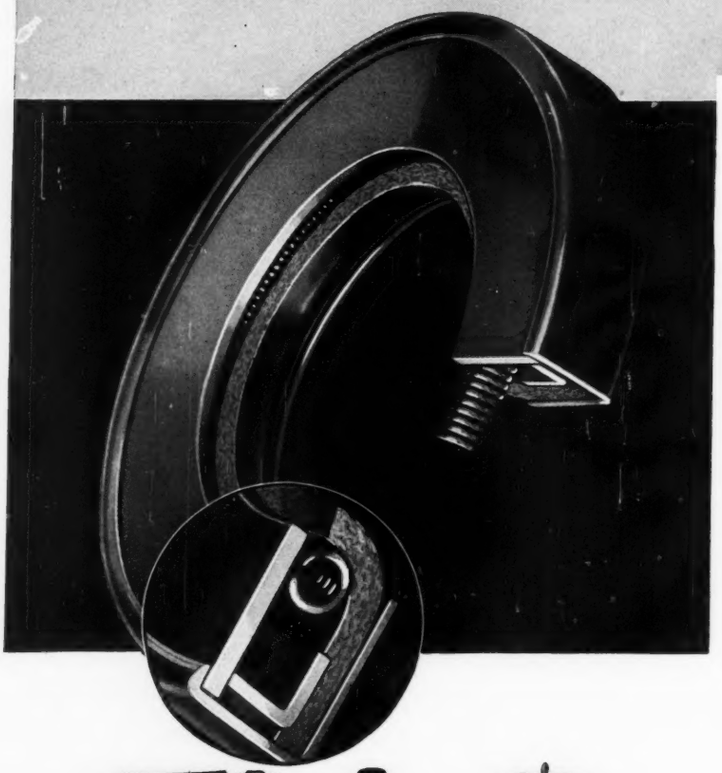

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PATENTED

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There are many ways to protect bearings but no device available today has the combination of structural and material advantages you secure in the Locked Spacer construction of the "Perfect" Oil Retainer. It seals the oil in the bearing and excludes all foreign matter. It is easier to install, takes less space and more punishment than other seals.

Standardize on the "Perfect" Oil Retainer as the cheapest means of maintaining good will and keeping your equipment sold.

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